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LARYNGECTOMY AND RADICAL NECK DISSECTION FOR CARCINOMA OF THE LARYNX*

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Combined laryngectomy and radical neck dissection is advocated for advanced laryngeal carcinoma because ultimate success is dependent upon the first surgical excision. Secondary operations necessitated by recurrent or metastatic carcinoma decrease the likelihood of a permanent cure. Incomplete removal of carcinoma not only stimulates the growth of cancer but it causes increased suffering and early death. Excision must be radical, widely encircle the tumor through normal tissue and avoid transection of involved lymphatic pathways.

Advanced laryngeal carcinoma with cervical lymph node involvement has been stated to constitute an inoperable situation and irradiation has been recommended as the therapy of choice.[1,27] In our experience, as well as others,[11,12,13,2,34,39,43,4,48,50,55] irradiation for metastatic carcinoma has been so uniformly unsatisfactory that radical surgery has appeared justifiable. The division of the operation into two stages (laryngectomy followed by radical neck dissection) has given unsatisfactory

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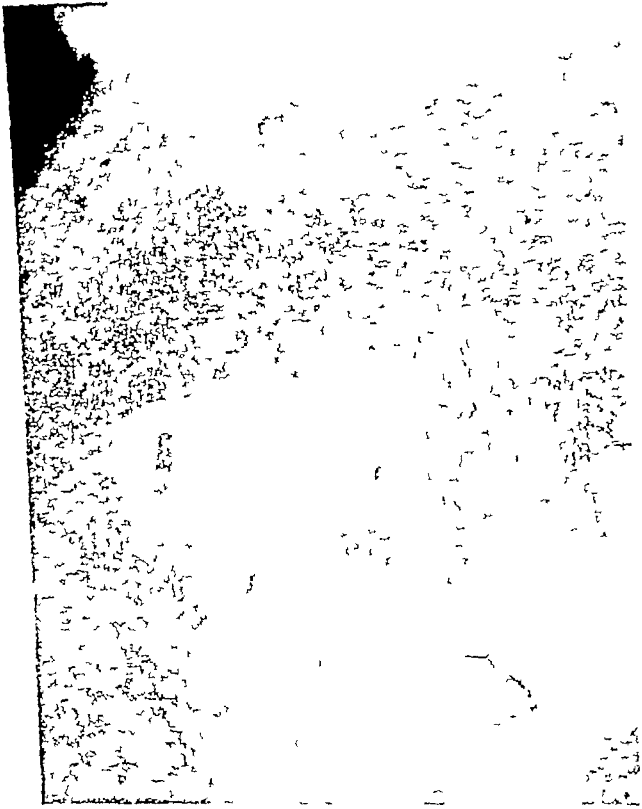

Fig. 1 Recurrent carcinoma destroying the cervical [illegible] [illegible] after a delayed two stage operation

Prophylactic neck dissection with laryngectomy should be performed in all advanced laryngeal carcinoma because of the frequency of microscopic nodal metastases in impalpable nodes (see Fig 2) The term "prophylactic" is used to modify the term radical neck dissection for an operation performed in the absence of palpable nodes The operation is used in conjunction with the excision of the primary lesion and not as a separate and independent procedure as is ordinarily understood by the term. Metastatic carcinoma constitutes the chief cause of late failures following laryngectomy. From a reported five-year cure rate of approximately 60 per cent,[12, 60] postoperative cervical metastases have been estimated to occur in 30 per cent of the laryngectomy cases without preoperative indication of their presence.[15] The late appearance of metas-

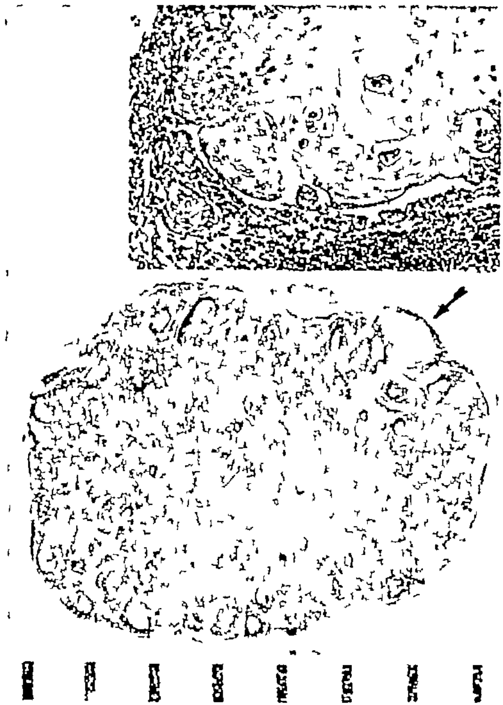

Fig. 2. The lower photomicrograph shows a tiny focus of metastatic carcinoma in a peripheral sinusoid of a cervical lymph node measuring [illegible] mm (prophylactic neck dissection). Each line at the bottom indicates 1 mm. The upper figure is a high power view.

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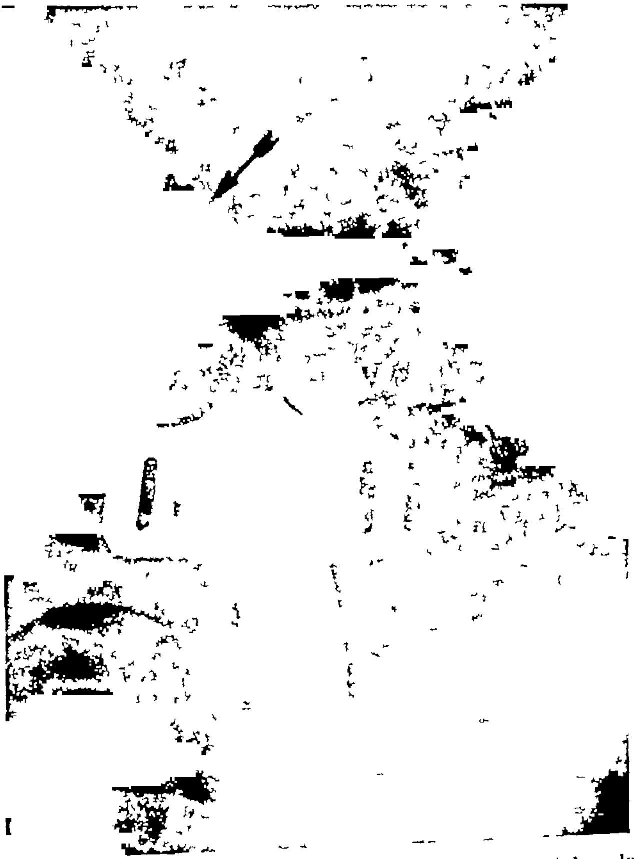

Fig 1 Recurrent carcinoma destroying the cervical vertebra late after a delayed two-stage operation

Prophylactic neck dissection with laryngectomy should be performed in all advanced laryngeal carcinoma because of the frequency of microscopic nodal metastases in impalpable nodes (see Fig 2) The term "prophylactic" is used to modify the term radical neck dissection for an operation performed in the absence of palpable nodes The operation is used in conjunction with the excision of the primary lesion and not as a separate and independent procedure as is ordinarily understood by the term Metastatic carcinoma constitutes the chief cause of late failures following laryngectomy From a reported five year cure rate of approximately 60 per cent,[12,30] postoperative cervical metastases have been estimated to occur in 30 per cent of the laryngectomy cases without preoperative indication of their presence[1] The late appearance of metas

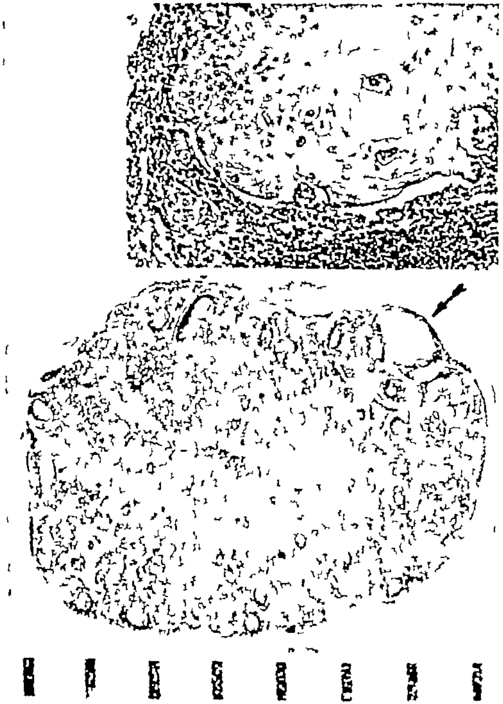

Fig [illegible] The lower photomicrograph shows a tiny focus of metastatic carcinoma in a peripheral sinusoid of a cervical lymph node measuring 7 mm (prophylactic neck dissection) Each line at the bottom indicates 1 mm The upper figure is a high power view tatic carcinoma, in the absence of local recurrence indicates that it must have existed originally in impalpable nodes, or in a small palpable node considered "clinically not significant" by the surgeon

Even with a most careful postoperative follow-up, many patients with late nodal metastasis after laryngectomy are

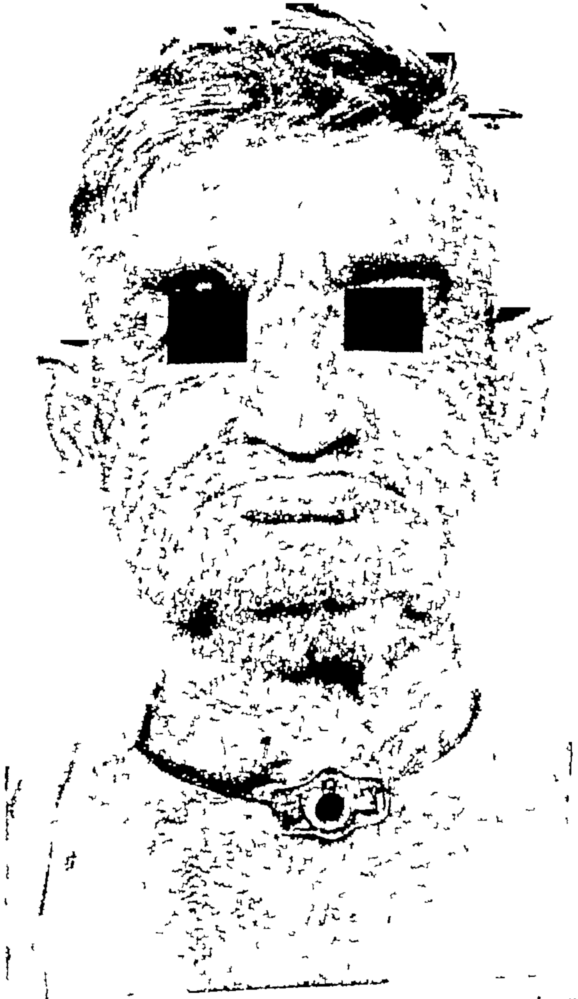

Fig Typical appearance of a firmly fixed metastatic carcinoma one year after laryngectomy for subglottic carcinoma doomed because of rapid growth and fixation of such lesions (see Fig 3) Furthermore, the frequent appearance of nodes *low* in the neck may be associated with mediastinal extension, or the carotid or internal jugular vein may be involved by a tumor thrombus (see Fig 4) It is obvious that success by radical neck dissection is less likely when palpable metastases exist than when a tiny solitary metastasis is present

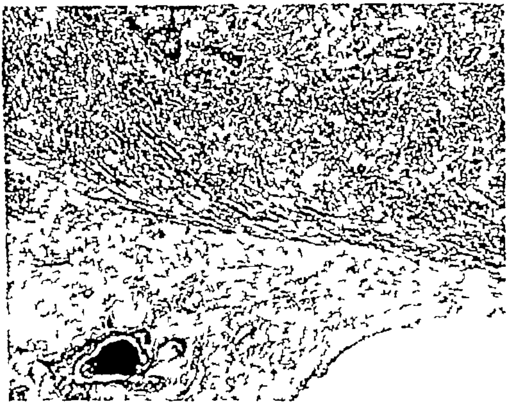

Fig 4 Tumor thrombus in the internal jugular vein

There should be no question at the first operation as to how much" or "how little" should be removed It is most essential that block neck dissection be complete Partial neck dissection or local excision of nodes have no place in the treatment of cervical metastases The emphasis is to excise the primary cancer and metastases widely and early before the nodes become clinically significant To "wait and feel" for nodes after laryngectomy will invite many failures Combined laryngectomy and neck dissection can be accomplished with little or no increase in the postoperative mortality rate as compared to laryngectomy Furthermore there is little difference in the cosmetic and functional results in the two procedures

HISTORICAL DEVELOPMENT

The first laryngectomy was reported by Billroth[8] in 1873. Until 1904 when Chevalier Jackson[26] gave the indications for and results of laryngofissure and laryngectomy, only a small number of cases were reported.[10,20,31,36,53] In 1904, Delavan[21] reported that out of 132 laryngectomies, 45 patients survived for varying periods up to 15 years. In 1905, LeBec[33] advocated the two-stage laryngectomy to avoid pulmonary complications. The two-stage method was again reported by Crile[1] in 1913, and by New[41] in 1928. At the Tenth International Congress of Otology in Paris in 1922, St. Clair Thomson, Tapia, Delavan, Moure, Regaud, Coutard, Chevalier Jackson and others gave a full account of the progress in the treatment of carcinoma of the larynx. In 1930, Sorenson reported 470 cases, of which 141 were free of disease five or more years later. Babcock in 1931 demonstrated the wide-field laryngectomy. Laurens[32] advocated the laryngectomy with "U" skin flap incision. Crowe and Broyles[19] reported a number of cases of laryngectomies where the external perichondrium was separated from the thyroid cartilage and used for a "stiffer" repair of the pharynx.

The end-results of laryngectomy have been disappointing in that there is a significant percentage of local recurrences and cervical metastases.

Orton[44] reported 94 patients with 23 recurrences. It was significant that in subglottic carcinoma, five cases out of 15 had late cervical metastases following laryngectomy. Jackson and Jackson,[27,28] reporting on 95 laryngectomies, found that 36 per cent of these were in good health three years or more after the operation. Of these, 31 eventually died of fatal recurrences and 16 cases developed late cervical metastases. Schall[50] found a five-year survival of 64 per cent, while New reported 60.2 per cent.

The value of radical neck dissection for metastatic squamous cell carcinoma was first described by Crile[16] in 1906. Brown and McDowell[11] and Martin[38] have recently stated that this form of surgery is a well accepted procedure.

In 1942, Sylvester Begnis[55] advocated the use of radical neck dissection and laryngectomy as a one-stage procedure He condemned the surgical extirpation of the larynx followed by irradiation therapy for clinically palpable nodes in the neck as suggested by Vasconcelos[40] Myerson[39] described two cases of extrinsic laryngeal carcinoma where a radical neck dissection was done first, followed a week later by a laryngectomy One of the two patients died later of pulmonary metastasis Kernan[3] in 1942 advised laryngectomy and radical neck dissection for extrinsic carcinoma of the larynx Brunschwig[12] in 1943 and Del Sel[22] in 1947 advised bilateral neck dissection and laryngectomy for carcinoma of the larynx Clerf[14] in 1948 stated that laryngectomy and prophylactic radical neck dissection were indicated in cases with questionable nodal involvement. In his series of 176 cases treated by laryngectomy alone, 81 were living well and free of recurrence five years later Forty-one out of 176 (24 per cent) showed late cervical lymph node metastases following laryngectomy Of the 41 block neck dissection was carried out in 21 cases with seven surviving for five years or more Of the 20 not treated surgically 15 of the 16 given irradiation died with cancer Pricolo[46] in 1948 published his technique for the one-stage removal of the larynx and cervical lymph nodes

LYMPHATICS OF THE LARYNX

The lymphatic supply of the larynx has been extensively studied by Rouviere[48] The lymphatics are divided by the true cord into the supraglottic and the infraglottic collecting chains as shown in Fig 5 The supraglottic chain which numbers four to six vessels on each side is united in the form of a lymphatic pedicle near the anterior part of the aryepiglottic fold The lymphatic pedicle penetrates to the pyriform sinus where it is united with the lymphatic trunk from the inferior part of the pharynx Fig 6 illustrates how this trunk traverses the thyrohyoid membrane, accompanied by the superior laryngeal vessels Some of the collecting trunks are joined with those of the pharynx and are reduced to three or four vessels The collecting trunks diverge at the lateral border of the thyrohyoid muscle One ascends and passes

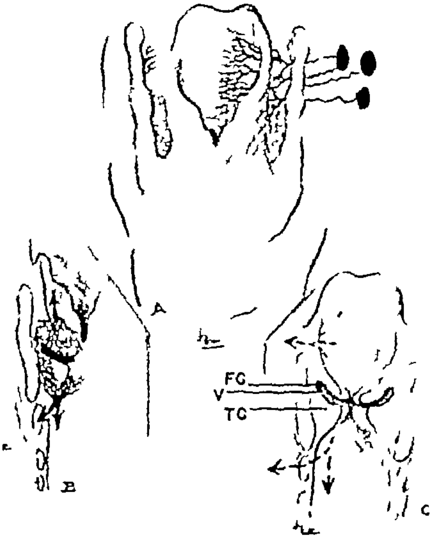

Fig 5 Lymphatics of the larynx and laryngopharynx. Supraglottic and infraglottic collecting pedicles FC—false cord V—ventricle TC—true cord

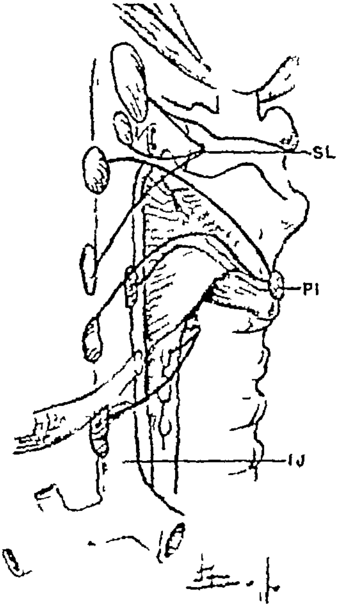

Fig 6 Lymph nodes about the internal jugular vein SL—superior laryngeal vessel opening PI—prelaryngeal IJ—internal jugular vein

laterally and superiorly along the greater cornu of the hyoid bone to the medial side of the hypoglossal nerve terminating in the subdigastric node One or several of the others pursue a somewhat more transverse course, and reach the nodes in the vicinity of the thyro-lingual-facial venous trunk, anterior and lateral to the internal jugular vein Still others pass obliquely inferiorly and laterally and reach one of the nodes placed along the internal jugular vein between the thyro-lingual facial trunk and the omohyoid muscle

The infraglottic collecting trunks are composed of three pedicles one anterior and two lateral posterior groups Of the anterior group the upper half traverses the cricothyroid membrane to the prelaryngeal node situated anteriorly between the thyroid and cricoid This in turn empties into nodes near the internal jugular vein between the thyro-lingual-facial venous trunk and the omohyoid muscle The lower half reaches the pretracheal nodes anteriorly between the cricoid and the first tracheal ring in front of the isthmus of the thyroid gland The nodes in turn drain into the internal jugular trunk as shown in Fig 7 The two lateral posterior col

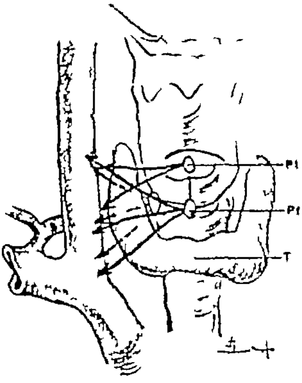

Fig Pretracheal and prelaryngeal lymph node Pl—prelaryngeal Pt—pretracheal T—thyroid lecting trunks traverse the cricotracheal membrane to reach the medial border of the lateral lobes of the thyroid gland From there they empty into the internal jugular vein nodes Fig 8 illustrates the rich lymphatic network in the neck and also the direction of lymphatic drainage

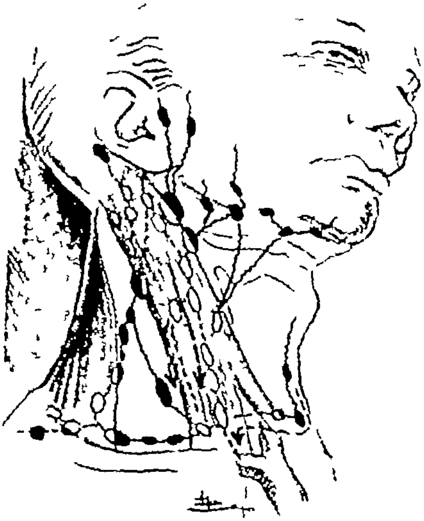

Fig 8 Cervical lymphatics

CLASSIFICATION OF CARCINOMA OF THE LARYNX

Since a great deal of confusion has surrounded the precise classification of carcinoma of the larynx, it is well for the purpose of this paper to clarify our terminology We have chosen to follow Walsh's[60] classification

1 Intrinsic is a tumor confined to the true vocal cord The cord must be movable The tumor may cross the anterior commissure and extend down the opposite cord

2 Endolaryngeal refers to all tumors within the voice box, that is, tumors that involve the ventricle, false cords, and/or fixation of vocal cord

3 Subglottic is a primary tumor that arises just beneath the true vocal cord Such a tumor is extensive when it

involves the true vocal cord A true cord carcinoma that extends supraglottic and/or subglottic is no longer intrinsic.

4 Extrinsic is a primary lesion that involves the epiglottis, aryepiglottic fold or pyriform sinus Postcricoid carcinoma is classified as esophageal in origin

EVOLUTION OF THE ONE-STAGE LARYNGECTOMY AND RADICAL NECK DISSECTION

Two principal factors appear to have stimulated the trend towards more radical surgical procedures in the treatment of carcinoma of the larynx

1 Roentgen therapy alone has failed to give satisfactory results

2 Laryngectomy for advanced carcinoma without apparent lymph node involvement has also failed in significant percentages Subsequent local recurrence and late metastatic carcinoma have been the chief causes for failures

Roentgen Therapy In the hands of radiologists who have advocated the use of external irradiation for laryngeal carcinoma, therapy guided by daily laryngeal observations has given satisfactory results in certain cases[1, 6, 19, 0, 20, 34]

For early carcinoma limited to one true vocal cord, the results by irradiation are good and almost approximate those of surgery[31] however, the results of X-ray therapy are poor where there is fixation of the arytenoid,[24] where the tumor is subglottic, or where the lesion involves the pyriform sinus[4, 20, 29]

In our experience, Roentgen therapy has been reserved only for extensive anaplastic lesions, where surgery is contraindicated due to extent or where surgery has been refused or deemed inadvisable because of the very poor physical condition of the patient

Our results have been uniformly unsatisfactory in those patients where cervical lymph node metastases have been treated by irradiation. Over the past 20 years, there have been no reported "five-year cures" with this treatment where metastases was proven by nodal biopsy.[11] Simmons[52] reported 108 cases and Forsell[24] reported 72 cases treated by external radium and Roentgen radiation without a single cure.

All of the reported five-year cures from irradiation, in which positive nodal biopsies were taken, have been the result of interstitial radiation from radon seeds implanted directly into the nodes after surgical exposure. Results reported from the Memorial Hospital[23,29] show not more than 2 per cent variation, in an approximate 20 per cent cure rate from surgery, and 4 per cent cure rate from irradiation (interstitial radon implants).

It is debatable whether irradiation will effectively sterilize even a small metastatic lymph node in *every* instance. Martin[38] has stated that a small metastatic node can be cured by external irradiation. Arbuckle[4] has reported that laryngeal carcinoma involving structures other than the true cord often shows microscopic metastases in nonpalpable cervical lymph nodes. He reports some clinical successes with external irradiation where biopsy of lymph nodes prior to therapy revealed microscopic carcinoma. Kernan[30] has suggested heavy X-ray therapy to the neck following laryngectomy in the absence of clinically palpable cervical nodes. It has been our experience that in some instances clinically positive nodes have appeared beyond the border of the treatment port.

Recurrent Carcinoma Following Laryngectomy

1. Local Recurrence. The type of laryngectomy performed is critical. There should be no question as to the method of laryngectomy once a decision has been made to remove the larynx. Only a wide field insures an adequate margin of safety. The importance of the pre-epiglottic space has been emphasized by Bisi[9] and Clerf.[13] If the narrow field approach is attempted, and the body of the hyoid bone split, the pre-epiglottic space is inevitably exposed. Since this space is frequently involved with tumor, and a safety margin in such an approach is not possible, extension into the base of the tongue is then likely to occur Not only is the prelaryngeal node frequently involved, but carcinoma may also extend beyond the confines of the cartilages and spread into the ribbon muscles[50 51] (see Fig 9) For this reason their separation from the cartilages should be avoided

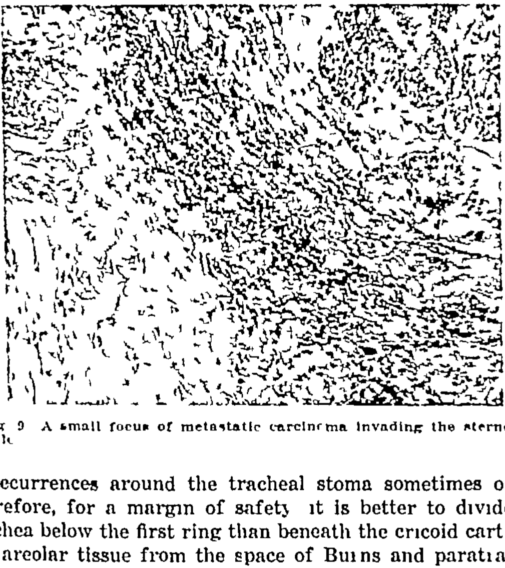

Fig 9 A small focus of metastatic carcinoma invading the sternohyoid muscle

Recurrences around the tracheal stoma sometimes occur, therefore, for a margin of safety it is better to divide the trachea below the first ring than beneath the cricoid cartilage All areolar tissue from the space of Burns and paratracheal areas is removed

There may be some question as to involvement of the thyroid gland when it is placed over the thyroid or cricoid cartilage for example in subglottic carcinoma If the isthmus is high over the first pretracheal ring it is frequently adjacent to a pretracheal node Under these circumstances the isthmus and/or one homolateral lobe of the thyroid is resected with the larynx (see Fig 10)

2 *Cervical Lymph Node Metastases* Cervical lymph node metastases are reported as high as 71 per cent in extrinsic carcinoma of the larynx[56] Metastases are frequent in subglottic and endolaryngeal carcinoma, but are very rare with intrinsic carcinoma limited to the true cord

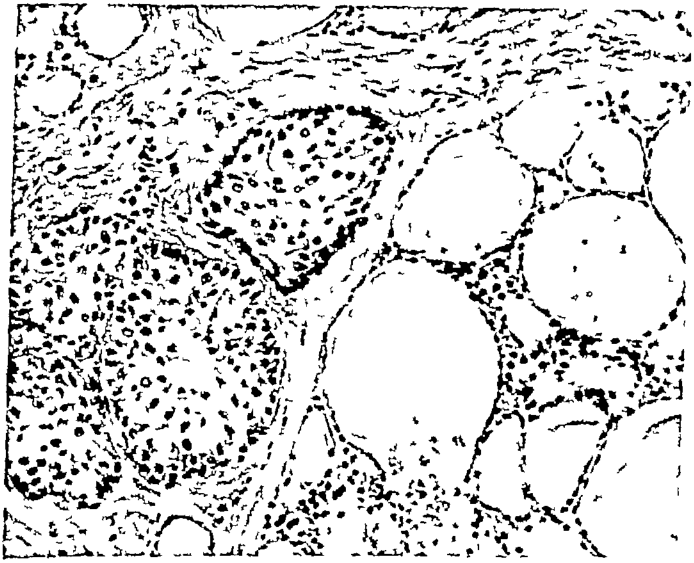

Fig 10 Metastatic carcinoma in lymphatic channels of the thyroid gland

SURGICAL INDICATIONS

Type and Local Extent of Primary Lesion In most instances, the lesions below will be unilateral

1 Subglottic carcinoma

2 Endolaryngeal carcinoma The tumor may extend into the aryepiglottic fold or into the pyriform sinus on the same side

3 Carcinoma of the aryepiglottic fold and/or the pyriform sinus Secondary cordal fixation or arytenoid edema is frequently present When a lesion of the pyriform sinus with cordal fixation or arytenoid edema

is present, it is important to determine the superior extent of the lesion The superior margin of the tumor must be below the level of the hyoid bone

> The following method has been satisfactory for determining this extent If the examining tip of the laryngoscope is just engaged on the tip of the epiglottis and the laryngoscope is then turned towards the side of the lesion, the superior margin of the tumor should be below the tip of the instrument

Nodes Unilateral, enlarged, solitary, firm, movable nodes are indicative for a combined laryngectomy and therapeutic radical neck dissection. Any enlarged palpable node not characteristic of carcinoma should be considered positive and have combined neck dissection and laryngectomy

In the *absence* of palpable nodes, carcinoma that involves the aryepiglottic fold, pyriform sinus, subglottic and endolaryngeal areas should have a *prophylactic* radical neck dissection with laryngectomy If exploration of the carotid sheath opposite the side of the lesion reveals questionable glands, bilateral neck dissection should be performed Bilateral prophylactic neck dissection with laryngectomy is indicated where the lesion is very extensive and involves both sides of the larynx

Grades In the past, Grades I and II were considered radioresistant, and more amenable to surgery, while Grades III and IV were considered radiosensitive While this is generally true, it is important to bear in mind that the term radiosensitivity is not synonymous with radiocurability A biopsy made from the vocal cord which shows Grade I or II may on reaching the extrinsic areas show Grade III or IV [27] Grading is therefore significant in that an anaplastic carcinoma is distinctly unfavorable because of its tendency to infiltrate the lymphatics early and to penetrate well beyond the apparent limits of the lesion What appears to be a limited lesion showing anaplastic carcinoma is better treated by the one-stage radical surgery followed by postoperative irradiation Occasionally radical surgery has been performed following completion of irradiation, for example, a very extensive lesion (Grade III or IV) considered "inoperable" may later become "operable" in that the lesion is reduced in size

Age A combined radical procedure is more advisable for the younger than for the older individual It is more important to consider the physical age than the chronological age

LIMITATIONS

A widefield laryngectomy without neck dissection is sufficient when an intrinsic lesion has extended too far for laryngofissure or other intralaryngeal procedures as advocated by LeJeune[35] An instance of this would be carcinoma on both true cords or one which *just* spreads into the ventricular or subglottic areas Another example would be where pathological examination of the laryngofissure specimen shows carcinoma at the surgical margins Secondary widefield laryngectomy is then performed It is a well known fact that cervical lymph node metastases occur very rarely under these circumstances

Extent of Primary Lesion This technique is not applicable where any one of the following conditions exist

1 Clinical invasion of base of tongue

2 The superior margin of tumor on the lateral laryngopharyngeal wall extends above the hyoid bone

3 Carcinoma involves the posterior laryngopharynx

4 Postcricoid carcinoma

5 Common party wall involvement

In the above areas, in addition to laryngectomy and neck dissection, the esophagus and/or pharynx must be resected similar to the technique described by Brunschwig[12] The Alonso[2,3] or Orton[43] procedures are applicable to certain extrinsic lesions where there is an absence of cordal or arytenoid involvement

Nodes Surgery is contraindicated when there is complete fixation of nodes It is of questionable value in the presence of large bilateral firm cervical metastases Bilateral metastases are unusual and are usually associated with inoperable far advanced bilateral laryngeal carcinoma Bilateral radical neck dissection with removal of both internal jugular veins in one stage has been performed in some cases [38]

Grade Any palpable metastases showing anaplastic carcinoma, despite movability is no longer limited Under these circumstances mediastinal extension is invariably present

General Irradiation is indicated in the following conditions

1 The local or metastatic lesion is "inoperable"

2 Distant metastases

3 The aged or very poor surgical risks

TECHNIQUE.

Anesthesia The skin is injected with 1 per cent novocaine Using heavy barbiturate premedication, local anesthesia may be used until the tracheal stump is delivered Gas, oxygen and ether endotracheal anesthesia supplemented by Demerol and Pentothal is then started

A "U' incision is marked out with methylene blue extending from one mastoid tip to the other (see Fig 11) The vertical arm extends along the posterior border of the sternocleidomastoid muscle while the horizontal part of the U is approximately one finger breadth above the suprasternal notch and the clavicle A small tongue of skin may be made at the lowermost border to aid in making a tracheal stoma

The skin flap is elevated from below until the body of the hyoid is exposed (see Fig 12) At the inferior and lateral border of the incision the skin is undermined for a short distance The superficial fascia is cut horizontally over the area of the tracheal stoma the anterior and external jugular

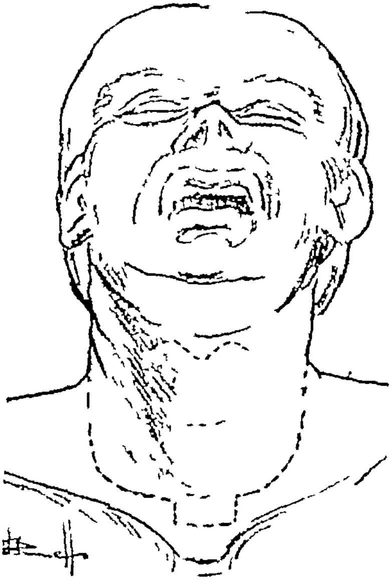

Fig 11 Outline for skin incision

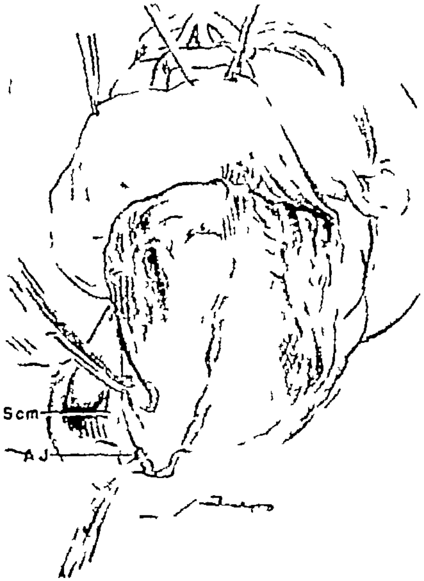

Fig 12 The skin flap is elevated Scm—sternocleidomastoid AJ—anterior jugular vein

veins are clamped, cut and ligated The sternohyoid and sternothyroid muscles are divided on each side and tied at a distance of 1 5 to 2 cm above the sternal attachment (see Fig 13)

There may be some question as to involvement of the thyroid gland when it is placed over the thyroid or cricoid cartilage, for example, in subglottic carcinoma If the isthmus is at or above the first tracheal ring, the isthmus and/or one homolateral lobe of the thyroid is resected with the larynx

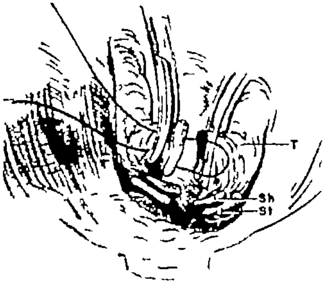

Fig 13 The thyroid isthmus is divided. Infrahyoid muscles are divided and ligated. T—thyroid Sh—sternohyoid St—sternothyroid.

In the event that the isthmus of the thyroid is low over the trachea and is uninvolved, the isthmus is clamped, divided and sutured (see Fig 13) The tracheal surface of each lobe is separated from the trachea Extreme care is taken not to free the posterior margin of the thyroid gland or cut the inferior thyroid artery or vein All areolar tissue anteriorly in the space of Burns and lateral to the tracheal stump is dissected from the tracheal rings and left attached to the anterior and lateral part of the first tracheal ring

Several drops of 10 per cent cocaine are next instilled into the trachea The trachea is opened horizontally between the first and second tracheal rings. A flap of mucous membrane from the posterior surface of the tracheal wall is fashioned *except* in any subglottic extension The flap from the posterior trachea is closed with the tongue of skin flap at the end of the operation Separation of the tracheal stoma from the esophagus is to be avoided because of the creation of dead space The tracheal stoma is anchored with heavy braided silk and buttons and endotracheal anesthesia is started (see Fig 14)

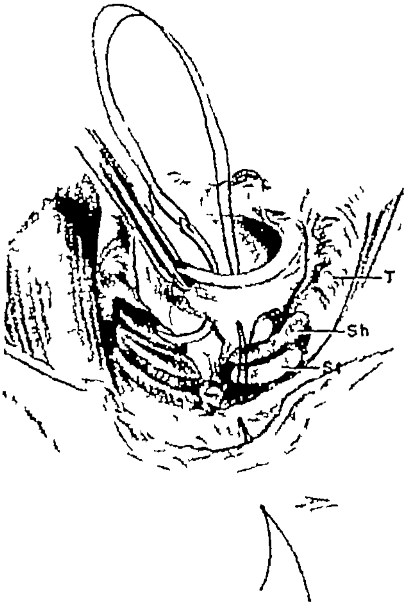

Fig 14 Fixation of the tracheal stoma T—thyroid Sh—sternohyoid St—sternothyroid

The extent of the laryngeal lesion is now determined through the open trachea The decision of bilateral neck dissection is made at this time In a unilateral lesion, one exposes and looks for questionable glands in the opposite carotid sheath If any are found, bilateral neck dissection is performed

Since in most instances glands are not found, from the side of the larynx *opposite* the location of the tumor, dissection is carried along the anterior border of the sternocleidomastoid muscle inferiorly, superiorly and posteriorly until the cricopharyngeus muscle is exposed The superior thyroid vessels are clamped and tied close to the thyroid gland. The omohyoid muscle is clamped, cut and ligated Separation of the larynx from the esophagus is carried up to the area of the arytenoid The arytenoid cartilage must not be exposed or the pharynx entered This avoids accidental dissection into the tumor The cricopharyngeus muscle on the uninvolved side is clamped and cut posteriorly to the inferior and superior cornu of the thyroid cartilage (see Fig 15)

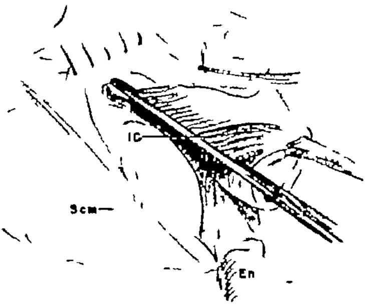

Fig 15 Mobilization of the larynx and division of inferior constrictors on the uninvolved side IC—Inferior constrictors Scm—sternocleidomastoid.

The cut muscle is not sutured The superior cornu of the thyroid is isolated, dissected free of the perichondrium close to the base of the lamina and is removed (see Fig 16) With a cautery knife, the superior border of the body of the hyoid bone is outlined separated from the suprahyoid muscles and isolated from the greater cornu of the uninvolved side to the lesser cornu of the involved side (see Fig 17) Dissection is carried into the vallecula, but the pharynx should not be opened The procedure is facilitated if a tenaculum is placed on the body of the hyoid for traction

In exposing the greater cornu of the hyoid the anterior jugular veins must be isolated, cut and tied (see Fig 18) The superior laryngeal artery and vein will next be identified

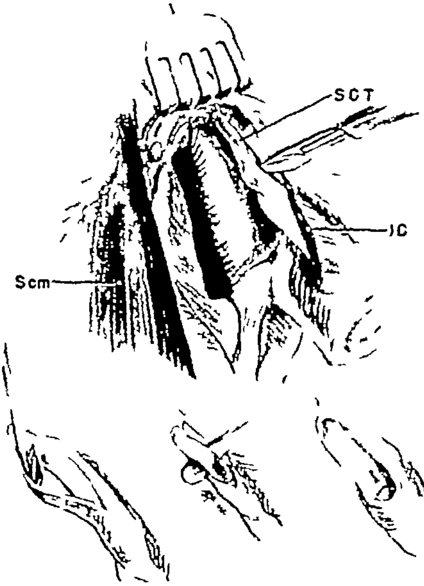

Fig 16 Removal of superior cornu of thyroid cartilage SCT—superior cornu of thyroid, Scm—sternocleidomastoid IC—inferior constrictors

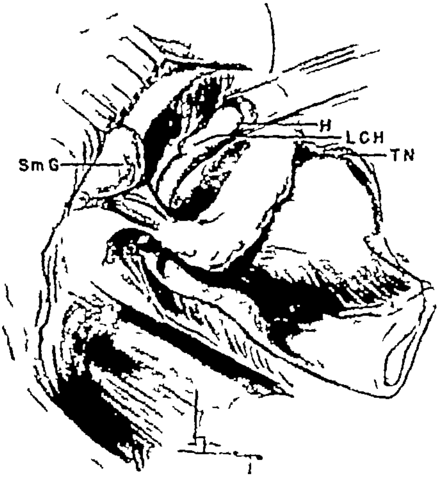

Fig 17 Separation of suprahyoid muscles from lesser cornu of involved side to greater cornu of uninvolved side of hyoid H—hyoid LCH—lesser cornu of hyoid TN—thyroid notch SmG—submaxillary gland

cut and ligated before they pierce the thyrohyoid membrane On the side away from the tumor the greater cornu of the hyoid bone is next released from its periosteal bed by incising and dissecting it away from the periosteum with a sharp elevator and scissors (see Fig 19)

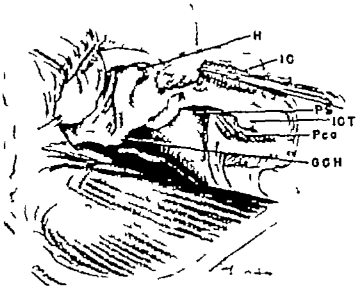

Fig 18 Pyriform sinus is exposed by rotating larynx towards involved side. H—hyoid IC—inferior constrictors PS—pyriform sinus ICT—inferior cornu thyroid Pca—posterior cricoarytenoid GCH—greater cornu hyoid

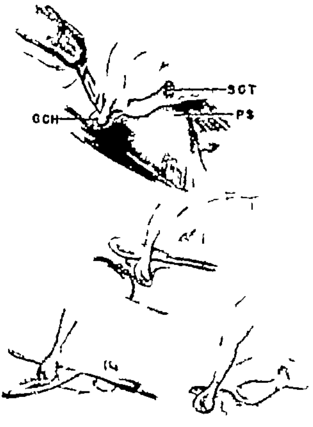

Fig 19 Greater cornu of hyoid is released from its periosteal bed GCH—greater cornu hyoid SCT—superior cornu thyroid (perichondrial bed) PS—pyriform sinus

With the larynx retracted and rotated towards the side of the tumor, the pyriform sinus is opened on the uninvolved side and the opening is enlarged, allowing direct inspection of the larynx proper and of the opposite pyriform sinus (see Fig 20) A tenaculum is inserted from below through the larynx, grasping the tip of the epiglottis and clearly exposing the vallecula and base of the tongue (see Fig 21) Where tumor involves the glottis, it is better to place the tenaculum

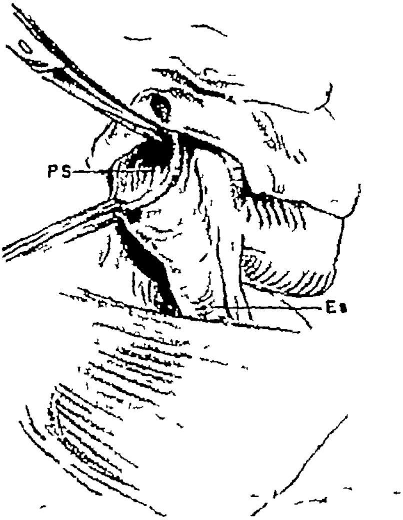

Fig 20 Pyriform sinus is opened on uninvolved side PS—pyriform sinus Es—esophagus

through the opening in the pyriform sinus With scissors, the opening of the pyriform sinus is enlarged by cutting across the base of the tongue, close to the epiglottis and aryepiglottic fold as well as posteriorly and inferiorly to the arytenoid (see Fig 21) By opening the pharynx in this fashion, the larynx may be rotated over to the side of the tumor and the margin of the tumor clearly defined There should be 2 to 2 5 cm of normal mucosa beyond the apparent limits of the tumor Dissection is now carried upwards along the posterior lateral wall of the hypopharynx On one side will be the larynx, the cut margin of the pyriform sinus with the lateral hypopharynx above it On the other side will be the margin of the

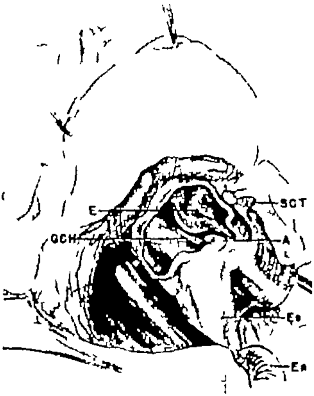

Fig 21 Pharyngeal stoma is enlarged by cutting posterior and inferior to the arytenoids and along the aryepiglottic fold and into the vallecula of the uninvolved side E—epiglottis A—arytenoid Es—esophagus En—endotracheal tube

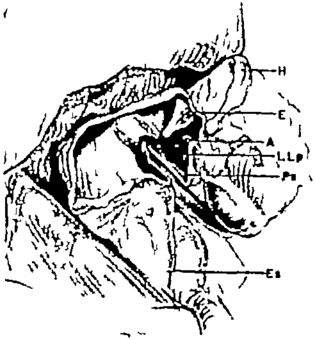

Fig Further separation of pharyngeal stoma from larynx and pyriform sinus E—epiglottis A—arytenoid LLp—lateral laryngopharynx PS—pyriform sinus.

normal posterior hypopharyngeal mucous membrane (see Fig 22) In so turning the larynx, the greater cornu of the hyoid and the thyroid lamina will mound into the pharynx and will serve as a landmark (see Fig 22) The dotted line (see Fig 23) indicates where the final separation of the larynx from the base of the tongue will be completed

To facilitate closure of the stoma, the cut edge of the hypopharyngeal mucosa is undermined (see Fig 24) A nasal feeding tube is put in place Using Dulox 000 chromic catgut, the stoma is closed by inverting its mucous membrane margins The corners or sutures are left long for landmarks (see Fig 25) Fig 26 shows the pharynx closed

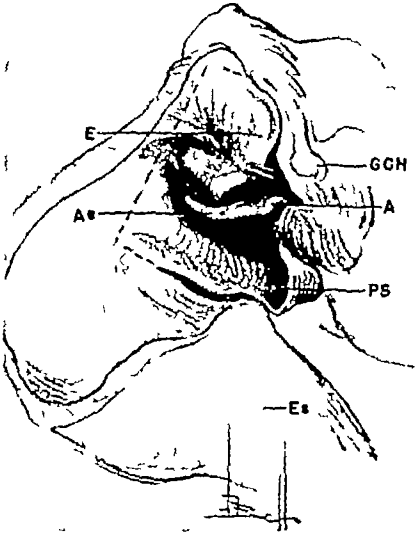

Fig 23 Outline of incision for complete separation of larynx from pharynx E—epiglottis GCH—greater cornu hyoid Ae—aryepiglottic fold A—arytenoid PS—pyriform sinus Es—esophagus

The radical neck dissection is now started (see Fig 26) The larynx is wrapped in gauze The sternal and clavicular heads of the sternocleidomastoid muscle are cut 2 cm from their attachments and sutured The omohyoid muscle is divided laterally and sutured (see Fig 27) The internal jugular vein is isolated low in the neck and separated from the

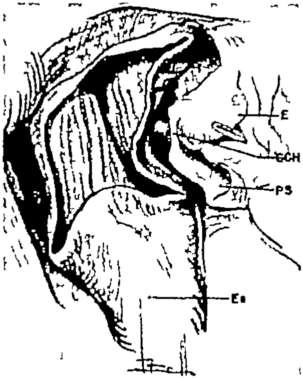

Fig 24 Pharyngeal stoma to be closed E—epiglottis GCH—greater cornu hyoid PS—pyriform sinus Es—esophagus

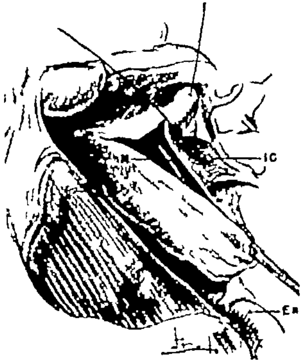

Fig   Closure of pharyngeal stoma. N—nasal feeding tube IC—Inferior constrictors En—endotracheal tube.

carotid artery and the vagus nerve doubly tied and transfixed On the left side of the neck great care must be exercised not to injure the thoracic duct The thoracic duct empties into

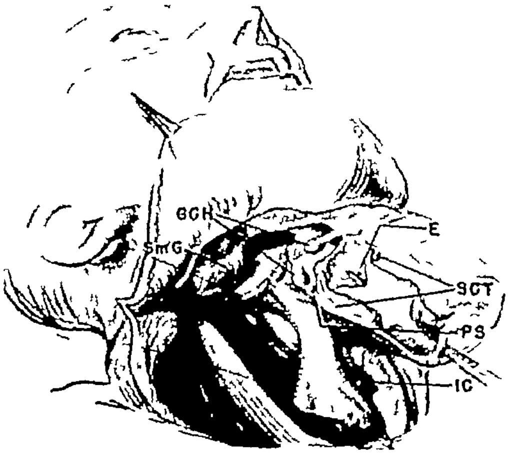

Fig 26 Pharynx closed Smg—submaxillary gland GCH—greater cornu hyoid E—epiglottis SCT—superior cornu thyroid PS—pyriform sinus IC—inferior constrictors (cut partially)

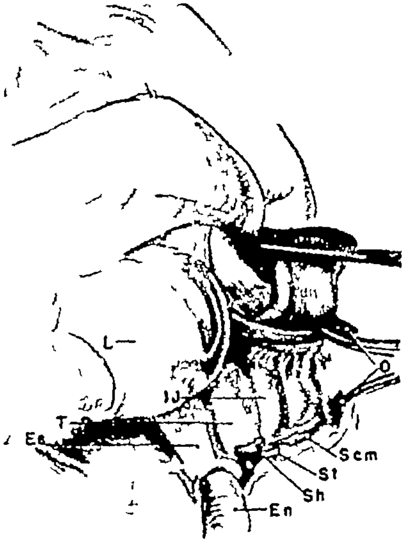

Fig 27 Radical neck dissection is started Sternocleidomastoid muscle is divided and ligated L—larynx (wrapped in gauze) IJ—internal jugular vein T—thyroid Es—esophagus Scm—sternocleidomastoid St—sternothyroid Sh—sternohyoid

the subclavian vein close to the internal jugular vein The internal jugular vein is dissected superiorly When the carotid sheath is opened the vagus nerve is seen lateral to the carotid artery (see Fig 28) As one dissects upwards over the lateral lobe of the thyroid, the superior thyroid artery and vein may be ligated Dissection over the carotid is carried up to the bifurcation In the event that a metastatic mass has occluded the common or internal carotid artery, the entire vessel should be sacrificed Hemiplegia should not result The cricopharyngeus muscle on the involved side should be cut

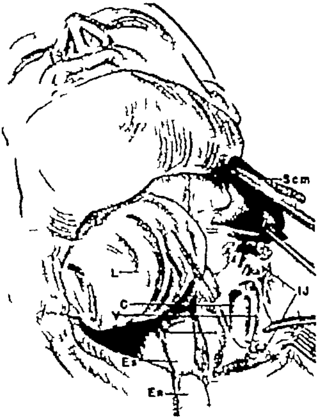

Fig 8 Internal jugular vein is ligated and the carotid sheath is opened IJ—Internal jugular vein C—carotid artery V—vagus T—thyroid Es—esophagus

posteriorly to the inferior cornu and the thyroid lamina. All areolar tissue overlying the prevertebral fascia is dissected from beneath the clavicle and laterally into the posterior triangle and reflected superiorly (see Fig 29)

Dissection of the areolar tissue is carried laterally until the anterior border of the trapezius muscle is reached At this point dissection is carried superiorly along its anterior border the spinal accessory nerve may be identified near the junction at the lower and middle one-third (see Fig 30)

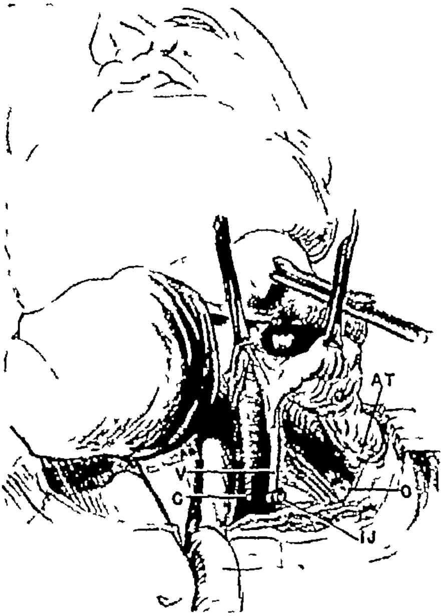

Fig 29 Dissection laterally into the posterior triangle O—omohyoid muscle AT—areolar tissue V—vagus C—carotid artery IJ—internal jugular vein

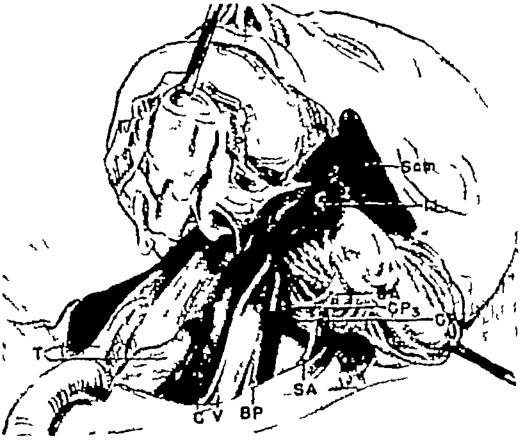

Fig 30 Dissection superiorly with division of the cervical plexus Identification of the spinal accessory nerve Scm—sternocleidomastoid GA—greater auricular nerve CP_3—cervical plexus III CP_4 cervical plexus IV SA—spinal accessory BP—brachial plexus T—thyroid C—carotid artery

Gentle pinching of this nerve with a smooth tip forceps will affect contraction of the shoulder In dissecting superiorly, anterior cervical rami 4 then rami C3, will be seen to enter the areolar tissue just lateral, posterior and inferior to the carotid bifurcation These are the cervical cutaneous sensory nerves and must be sectioned

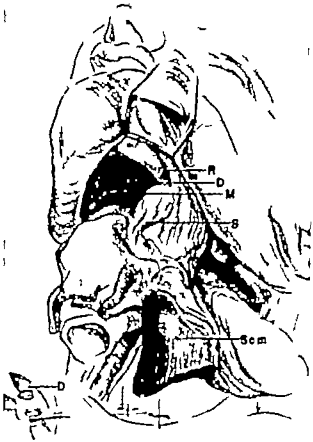

Fig 31 Submental triangle is exposed. Anterior belly of digastric muscle is divided. R—ramus of mandible D—digastric M—mylohyoid muscle S—submental fat Scm—sternocleidomastoid

The spinal accessory nerve will perforate the sternocleidomastoid muscle at the junction of the upper and middle one-thirds on its posterior and inferior border on its way to the trapezius Often a sensory branch from C3 will anastomose with the spinal accessory at this point The greater auricular nerve which curves around the posterior border of the sternocleidomastoid muscle is resected The spinal accessory nerve must be dissected free and allowed to drop posteriorly by cutting the fibres of the sternomastoid muscle In the event that the spinal accessory nerve runs through or adjacent to ques tionable or positive nodes, it must be sacrificed As one dissects superiorly the spinal accessory nerve will be seen to be just lateral to the internal jugular vein

In the submental space areolar tissue is dissected down to the mylohyoid muscle and reflected laterally along the ramus of the mandible (see Fig 31) The anterior belly of the digastric muscle is identified, clamped, sectioned and tied (see Fig 32) The submaxillary gland and lymph nodes are reflected laterally and the duct of the submaxillary gland turning behind the mylohyoid muscle is ligated and cut The facial artery and vein are identified at the ramus of the mandible, clamped, cut and tied (see Fig 33) The lingual nerve is close to the submaxillary duct and should be preserved

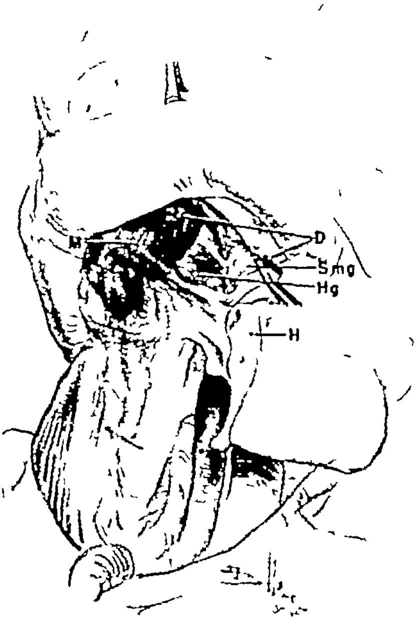

Fig 32 Submaxillary gland is separated to where its duct turns behind the mylohyoid muscle D—digastric Smg—submaxillary gland Hg—hyoglossus H—hyoid

The lower figure (see Fig 33) shows the hypoglossal nerve as it is ideally visualized It is more frequently not seen in this area, because after releasing the suprahyoid muscles from the hyoid bone, usual anatomical landmarks are lost. The nerve will be easily cut on further lateral dissection. For this reason dissection is now carried superiorly from below The superior thyroid artery will be identified as the first branch of the external carotid artery This should be cut and doubly ligated (see Fig 34) The hypoglossal nerve can be seen to arise between the internal and external carotid artery (see Fig 35) crossing over the latter and following the course of the lingual artery to enter the tongue between the mylohyoid and the hyoglossus muscles (see Fig 36) The hypoglossal nerve is freed along its entire course and allowed to drop into its new position The XIIth nerve is sacrificed if it is adjacent to or involved with questionable or positive nodes

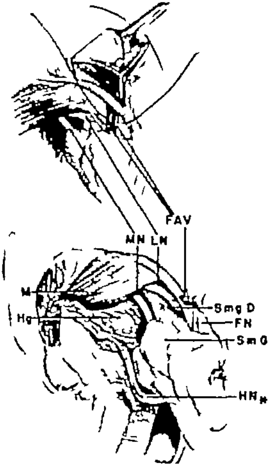

Fig 33 Submaxillary gland area. FAV—facial artery vein LN—lingual nerve MN—mylohyoid nerve M—mylohyoid Hg—hyoglossus Smg D—submaxillary gland duct HN—hypoglossal nerve (usually not visualized)

In dissecting posteriorly at the angle of the mandible the tail of the parotid gland is cut (see Fig 36) The cervicomaxillary branch of the facial nerve is sometimes sectioned

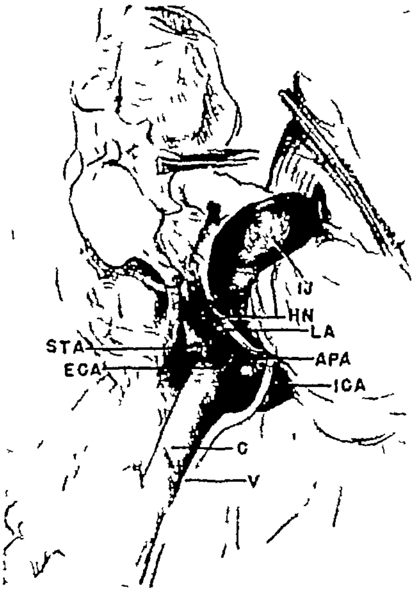

Fig 34 Relationships of hypoglossal nerve HN—hypoglossal nerve LA—lingual artery STA—superior thyroid artery ECA—external carotid artery APA—ascending pharyngeal artery IJ—internal jugular vein

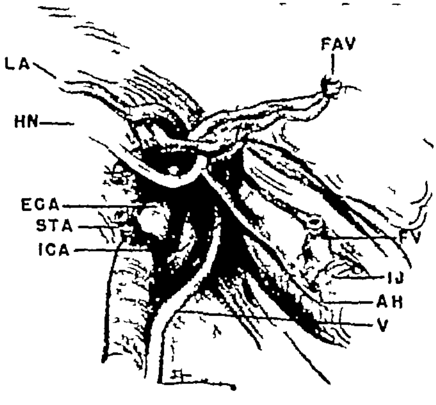

Fig 35 Relationships at bifurcation of carotid artery LA—lingual artery FAV—facial artery vein HN—hypoglossal nerve ECA—external carotid artery STA—superior thyroid artery ICA—internal carotid artery FV—facial vein IJ—internal jugular vein AH—ansa hypoglossal V—vagus

as it may extend as low as one inch below the angle of the jaw The facial artery is doubly ligated at its origin The internal jugular vein is separated and doubly ligated and

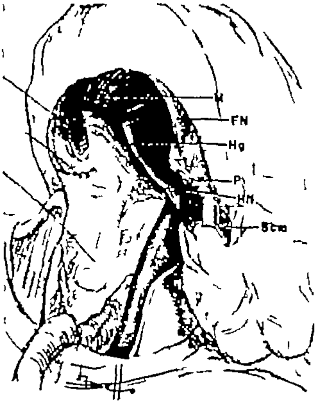

Fig 36 Isolation of hypoglossal nerve and division of the tail of parotid gland. M—mylohyoid FN—facial nerve (cervicomaxillary) Hg—hyoglossus P—parotid gland HN—hypoglossal nerve Scm—sternocleidomastoid

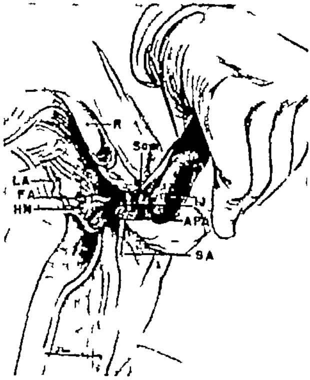

Fig 3 Ligation of internal jugular vein under the jugular foramen R—ramus of mandible LA—lingual artery FA—facial artery HN—hypoglossal nerve IJ—internal jugular vein SA—spinal accessory

transfixed beneath the jugular foramen (see Fig 37) Finally, the sternocleidomastoid is sectioned close to the mastoid attachments, as are the lesser muscle groups, that is, the digastric and the stylohyoid muscles The final anatomical structures visualized at the end of the operation are illustrated in Fig 38 If a bilateral neck dissection is indicated at one stage, a neck dissection with removal of areolar tissue and lymph nodes with preservation of the internal jugular vein is performed Block dissection is completed, followed by a laryngectomy and complete neck dissection with removal of the internal jugular vein on the major side Both internal jugular veins can be excised at one time An alternative is to delay neck dissection six to eight weeks as a second stage after combined laryngectomy and neck dissection The re-

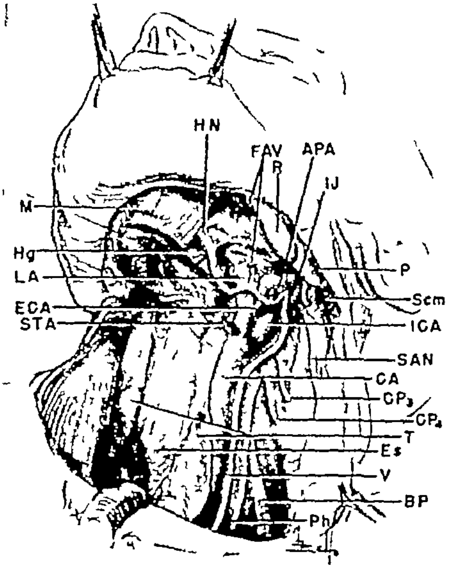

Fig 38 Anatomy of completed laryngectomy and radical neck dissection STA—superior thyroid artery ECA—external carotid artery LA—lingual artery Hg—hyoglossus muscle M—mylohyoid muscle HN—hypoglossal nerve FAV—facial artery and vein R—ramus of mandible APA—ascending pharyngeal artery IJ—internal jugular vein P—parotid Scm—sternocleidomastoid muscle ICA—internal carotid artery SAN—spinal accessory nerve CA—common carotid artery CP_3—cervical plexus III CP_4—cervical plexus IV T—thyroid Es—esophagus BP—brachial plexus Ph—phrenic nerve

maining jugular vein can be removed This is possible at this time because of the establishment of collateral circulation

The pharynx is reinforced with two rows of interrupted silk sutures The cricopharyngeus muscles are overlapped and the two thyroid lobes may be sutured together The wound is thoroughly irrigated with warm saline solution The skin margin is closed with interrupted subcutaneous and fine black silk Two Penrose drains are placed through a stab wound, lateral to the lower incision. The tracheal stoma is placed so that the tongue of skin is approximated to the posterior wall of the trachea.

A tight bandage is applied with mechanic s waste and reinforced with elastoplast. Two to three units of blood are usually given during the operation Chemotherapy and antibiotics are given for one week A high protein, high caloric tube feeding is given for one week It is important that the patient be asked not to swallow saliva and other secretions for one week Sips of water may be tried by mouth on the eighth day If there is no leakage, feeding by mouth may be started at the end of the eighth day and the nasal feeding tube removed If leakage occurs, parenteral or tube feeding should be given until the fistula has closed

DISCUSSION OF CASES

In our series, radical neck dissection and laryngectomy was performed in 37 patients Ten patients were done in two stages and 27 patients in one stage A brief summary of each case, nodal findings and results to date are summarized in Tables I II III and IV

One-Stage Twenty seven consecutive patients considered operable had combined laryngectomy and radical neck dissection These patients may be further divided into those with positive nodes those with enlarged palpable nodes and those without palpable nodes There was no immediate postoperative mortality One died of cardiac and pulmonary complications at the end of the fifth week. Twenty are living well and free of disease Three cases with recurrent carcinoma are "controlled" by irradiation To date, contralateral cervical metastases have not appeared in any instance where the lesion was unilateral

Six patients clinically showed positive nodes at the time of surgery Of these, two are living and well to date Two cases known to have a small metastasis, in the anterior superior mediastinum at surgery but not seen by X-ray, received heavy postoperative irradiation One patient died seven months later from a second primary carcinoma

Three patients present enlarged palpable nodes not characteristic of carcinoma, on the same side as the primary lesion

TABLE I

ONE STAGE

NO	INITIALS	AGE	SEX	COLOR	UNIL. OR BIL.	DATE	LOCATION LESION	GRADE	NODES CLIN	MICROS NODES	STATUS	DATE
1	J B *	64	L	W	UNIL.	9/47	Left, False True, Subg Pyriform	3	Neg	Pos	D	1 year Broncho Pneumonia
2	H W	65	M	C	UNIL.	3/48	Left, True False, Subg Vent	2	Neg	Neg	A	
3	E K *	54	M	W	UNIL.	8/48	Rt Arytenoid Pyriform Lateral Wall Pharynx	3	Neg	Neg	A	
4	O T	23	M	W	UNIL.	1/49	Rt False Vent True	3	Pos	Pos	A	
5	H O *	53	M	W	BIL.	4/49	Rt and Lt False, True Vent Subg	2	Neg	Pos	A	Recurrence in Thyroid
6	C S	65	M	W	UNIL.	10/49	Rt False, True Epig Ary-Epig	2	Neg	Neg	A	
7	A P	67	M	W	UNIL	11/49	Rt False Vent True	2	?Pos	Neg	A	
8	B R	66	M	W	UNIL.	1/50	Rt False True, Vent	2	Neg	Neg	A	
9	G S	68	M	W	UNIL.	2/50	Rt False True, Ary-epig	3	Neg	Neg	A	
10	E S	59	M	W	UNIL.	3/50	Lt Cord Vent	2	Neg	Neg	A	
11	G M	65	M	C	UNIL	3/50	Lt Cord Subg	2	Neg	Pos	A	
12	J K	54	M	W	UNIL.	3/50	Lt Pyriform Arytenoid	3	Pos	Pos	A	Recurrence Lt Neck
13	J L.	61	M	W	UNIL.	5/50	Rt Cord Subg	Adeno Ca	Pos	Pos	D	5 weeks Post-op

TABLE I (CONTINUED)

NO	INITIALS	AGE	SEX	COLOR	UNIL. OR BIL.	DATE	LOCATION LESION	GRADE	NODES CLIN	MICROS NODES	STATUS	DATE.
14	J W	64	M	W	UNIL.	6/50	Rt False True Cord Vent.	3	Neg	Neg	A	
15	B.P	66	M	W	UNIL.	8/50	Rt.Ary Epig Pyriform Arytenoid	3	Pos	Pos	A	
16	F M	58	M	W	UNIL.	8/50	Rt.False Vent True	3	Neg	Pos	A	
17	J B	60	M	W	UNIL.	11/50	Rt.Ary-Epig Pyriform base Epig False,Ary	3	Pos	Pos	A	Recurrence in neck ?Mediastinum
18	E.M.	30	M	W	UNIL.	12/50	Rt.False True Subgl.Base Epig	4	Neg	Neg	A	
19	W.M.	62	M	W	UNIL.	3/51	Lt.True Subgl.	3	Neg	Neg	A.	
20	C.L.*	60	M	W	UNIL.	4/51	Lt.Pyriform Arytenoid	3	Pos	Pos	D.	Second Primary Carcinoma
21.	J K.	64	M	W	UNIL.	5/51	Lt.Vent True Cord	3	?Pos	Neg	A	
22	L.E.	51	M	W	UNIL.	5/51	Rt.Cord Subglottic	2	Neg	Pos	A.	
23	M.A	69	M	C	UNIL.	5/51	Rt.Ary-Epig Arytenoid	3	?Pos	Pos	D	Second Primary Carcinoma
24.	F.A	66	M	W	UNIL.	5/51	Lt.Ary-Epig False,Arytenoid	2	Neg	Neg	A	
25	G.C.	49	M	W	UNIL.	5/51	Lt.Subglottic	3	Neg	Neg	A	
26.	F.R	56	M	W	UNIL.	5/51	Lt.Subglottic True Vent.	3	Neg	Pos	A	
27	E.K	61	M	W	UNIL.	6/51	Lt.Subglottic True Cord	2	Neg	Pos	A	

* ROENTGEN THERAPY PRIOR TO SURGERY

Two are well at the present time In the remaining patient metastatic carcinoma was found in a single node. This patient later died of a second primary carcinoma

Eighteen consecutive cases with advanced carcinoma without palpable nodes had prophylactic radical neck dissection Seven of these had microscopic metastases in the cervical lymph nodes Microscopic positive nodes were found in six out of 15 instances of subglottic and endolaryngeal carcinoma The remaining one of the three occurred with extrinsic carcinoma In five of the seven specimens a solitary soft node less

TABLE II

TWO STAGES

NO	INITIALS	AGE	SEX	COLOR	UNIL OR BIL	DATE	LOCATION LESION	GRADE	NODES CLIN	MICROS NODES	STATUS	DATE
1	C K	60	M	W	UNIL.	L 5/44 ND 2/49	True,Vent Rt False	2	Neg→Pos	Pos	A	
2	C H	49	M	W	UNIL.	L.5/44 ND 7/48	Cord Fixed Rt True	2	Neg→Pos	Pos	D	2½ years Recurrence
3	A R	60	M	W	UNIL.	L.8/47 ND 9/48	True,Vent Lt False	2	Neg→Pos	Pos	D	3 years Recurrence
4	H C	56	M	W	UNIL	L.11/47 (ND)11/47	Lt Arytenoid Pyriform	3	Pos	Pos	D	1 year Recurrence
5	P S	67	M	W	UNIL.	L 11/47 (ND)12/47	Rt Ary-Epig False,True Subg	3	Pos	Pos	D	8 months Recurrence
6	P R	63	M	W	UNIL.	L.12/47 (ND)12/47	Rt Arytenoid Pyriform	3	Pos	Pos	D	2½ years Recurrence
7	F S	67	M	W	BIL.	L 1/48 (ND)2/48	Ary-Epig Subg	2	?Pos	Neg	A	
8	C S	66	M	W	UNIL.	L 7/48 ND 6/49	Rt False Vent	2	Neg→Pos	Pos	D	2½ years Recurrence
9	J E	41	F	C	UNIL.	L 12/48 ND 1/49	Rt False True Subg	2	?Pos	Neg	A	
10	J C	67	M	W	UNIL	(ND)5/49 L.6/49	Rt Arytenoid Pyriform	3	Pos	Pos	D	5 months Recurrence

L. Laryngectomy

ND Neck Dissection

(ND) Neck Dissection Delayed

TABLE III
SUMMARY OF ONE- AND TWO STAGE CASES

Total		37
Two stages	10	
Neck dissection two weeks after laryngectomy	4	
Neck dissection late after laryngectomy	4	
Neck dissection two weeks after laryngectomy enlarged palpable nodes, negative microscopic bilateral neck dissection (1)	2	
Prophylactic neck dissection	0	
One stage		27
Neck dissection with laryngectomy, positive nodes	6	
Neck dissection with laryngectomy enlarged palpable nodes positive microscopic	1	
Neck dissection with laryngectomy enlarged palpable nodes negative microscopic	2	
Prophylactic neck dissection with laryngectomy		18
Negative microscopic	11	
Positive microscopic	7	
Bilateral neck dissection (1)		

TABLE IV
RESULTS

Postoperative mortality immediate	0
Postoperative mortality end of fifth week	1
Late mortality	
Local recurrences (two stages)	7
Bronchopneumonia (one stage)	1
Second primary carcinoma (one stage)	2
Clinically controlled	
Living with no recurrence (two stages)	3
Living with no recurrence (one stage)	20
Positive node cases	2
Enlarged palpable node cases	2
Prophylactic neck dissection cases	16
Living and "controlled" with irradiation (one stage)	
Recurrent in neck (positive node cases)	2
Recurrent in thyroid	1

than a centimeter in its greatest length, showed microscopic carcinoma in the peripheral sinusoid In two specimens a single node measuring 1 5 cm felt questionably firmer than usual Sixteen patients are free of disease One patient who later developed a recurrence in the thyroid gland is now 'controlled" by irradiation Another patient died a year later from bronchopneumonia

Five patients had combined neck dissection and laryngectomy following completion of X-ray therapy In these instances the lesions were very advanced and residual tumor remained after irradiation therapy In three of the five tumor was found in the nodes in spite of external irradiation Three of the five are free from disease at the present time

Except for eight cases which developed temporary pharyngeal fistula, all healed within a two weeks postoperative period Of these fistulae five closed within three weeks and three persisted for four weeks (received preoperative X-ray therapy) Permanent fistula did not occur in any instance, and secondary repair of a fistula was not necessary

A good esophageal voice was obtained in 75 per cent of the cases and nearly all could do without a tracheotomy tube after three months The cosmetic result and specimen are illustrated in Figs 39, 40 41 and 42

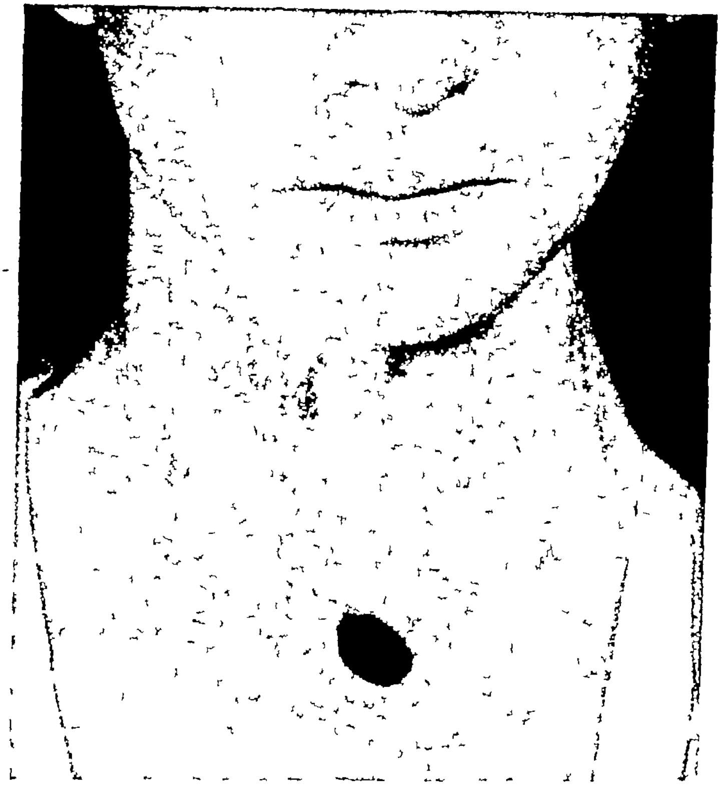

Fig 19 Patient No 1 Postoperative laryngectomy and radical neck dissection

Two-Stage In the presence of positive nodes, radical neck dissection was delayed one to two weeks after laryngectomy in four instances All four patients eventually died with local recurrences, in spite of heavy postoperative irradiation In one instance, the tumor recurred in the interval between the neck dissection and laryngectomy and eroded the transverse process of the vertebrae

Two patients are clinically well where neck dissection was delayed for enlarged palpable nodes which were microscopically negative

Delayed radical neck dissection was performed in four patients where metastatic nodes appeared late Subsequently, three of the four died with mediastinal extension and local

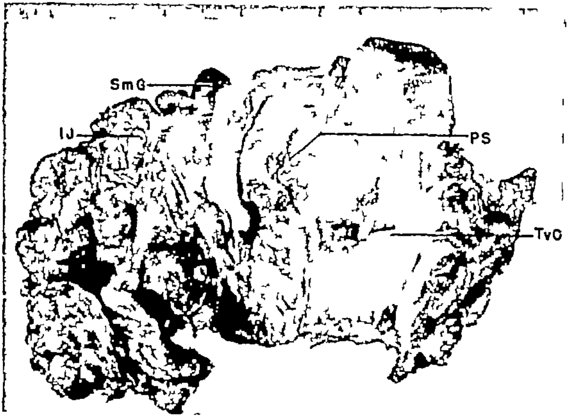

Fig 40 Specimen of Patient No 1 TvC—true vocal cord PS—pyriform sinus.

Fig 41 Patient No 2 Postoperative functional result

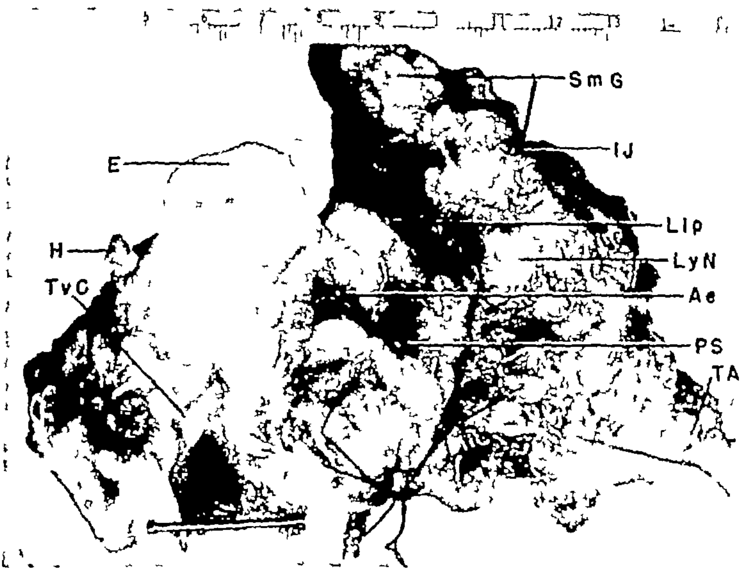

Fig 42 Specimen of Patient No 2 E—epiglottis H—hyoid TvC—true vocal cord SmG—submaxillary gland Llp—lateral laryngopharynx LyN—lymph node (positive) Ae—aryepiglottic fold carcinoma PS—pyriform sinus TA—areolar tissue

recurrences Contralateral cervical metastases did not occur in any instance Only one case remained clinically well where late nodal metastases were removed by radical neck dissection

DISCUSSION

It is emphasized that combined radical neck dissection and *laryngectomy for advanced carcinoma of the larynx* is advocated at the first surgical excision Neck dissection is considered "therapeutic" when associated with metastatic cervical nodes or with palpable enlarged nodes not characteristic of carcinoma

The technique proposed is not only ideal for subglottic, ventricular, and false cord carcinoma, but it has been extended to include carcinoma of the aryepiglottic fold and of the pyriform sinus

Dividing the operation into two stages will cut involved lymphatic pathways, which is contrary to sound surgical principles The two-stage operation has given poor results. All four patients treated in this manner eventually died with local recurrence and mediastinal extension Only one patient out of four is living and free from recurrence when neck dissection was performed for clinically positive nodes late after laryngectomy

A number of instances of laryngeal carcinoma is handled by less radical surgical measures A widefield laryngectomy alone will be sufficient where laryngofissure or other intralaryngeal methods are not applicable Neck dissection is omitted since it is a well known fact that cervical lymph node metastases occur very rarely under these circumstances

Combined prophylactic neck dissection and widefield laryngectomy is advocated where the primary tumor involves the rich lymphatic areas It has been demonstrated that in advanced carcinoma of the larynx microscopic metastases exist frequently in impalpable nodes The combined operation is performed when the vocal cord is fixed, or when carcinoma involves the subglottic, ventricular or false cord areas The procedure has been extended to include carcinoma of the aryepiglottic fold and pyriform sinus where cordal fixation or arytenoid edema is present Bilateral prophylactic neck dissection with laryngectomy is performed when the lesion is very advanced and on both sides of the larynx, or if questionable nodes are found contralateral to a unilateral lesion

There can be little question that neck dissection performed in the one stage operation will result in more cures when metastases are clinically impalpable than when surgery is performed in the presence of palpable metastatic nodes, or in two stages after the appearance of late metastatic nodes The end results of radical surgery in carcinoma of the breast shows the cure rate is the highest where there is no metastasis present less with microscopic metastases and least where palpable adenopathy is present.[1] Even in the last group surgery will give the best results rather than radiation In our series where the combined operation was performed in the absence of palpable nodes pathologic examination of the cer vical lymphatics showed microscopic carcinoma in one or more nodes *in seven out of 18 patients* (*six out of 15 instances of* subglottic and endolaryngeal carcinoma, or 40 per cent) Since Saphir[10] has shown that the percentage of microscopic metastases can be increased by serial section of previously reported "negative nodes," the percentage of microscopic metastases should be even higher than 38 8 per cent It has not been our standard practice to serially section every node removed from the neck dissection

As mentioned previously, most of the microscopic metastases occurred in soft nodes under 1 cm It is impossible to palpate such a small soft node or even a questionable node, measuring 1 cm or slightly larger, in a muscular neck or low under the sternocleidomastoid muscle

To explore the carotid sheath for a questionable node is of some value, but to perform frozen sections of a node before neck dissection has not always been reliable, furthermore, from our experience one cannot always predict which node will be involved A microscopic metastasis from subglottic carcinoma may be present in a jugulodigastric node, mid-deep cervical node or in one low in the neck For those who oppose prophylactic neck dissection on the premise that two needless neck dissections were done to benefit one, there is no certain method other than radical surgery at the present time to determine which one out of the three harbors the metastasis

It has been mentioned previously that many radiologists maintain that metastatic carcinoma is seldom cured by irradiation On the other hand, others have stated that radiation can cure a small metastatic node One often fails, however, to cure multiple impalpable nodes when irradiation is directed over a metastatic node through a small port Neck dissection may succeed more often in such situations, particularly since block dissection can cover the clavicle to the mandible, whereas irradiation therapy in cancer-lethal doses over such a large area could not possibly be tolerated by the patient Postoperative irradiation is reserved only for those patients where there is a question as to the surgical margin of safety For example if the lowermost node in the neck dissection is positive, radiation is directed over the superior mediastinum Irradiation therapy is given with the hope that a small metastasis may be cured, whereas a large one never will be

Radiation therapy is indicated where an extensive anaplastic carcinoma precludes surgery If after maximum irradiation, the lesion is still present, though much decreased in size, radical surgery *may* be of value Surgery will be most difficult under these circumstances

The postoperative mortality of the extended procedure is low If we consider a two-week postoperative period, the mortality for laryngectomy is as low as 1 5 per cent[12] When one included extrinsic carcinoma, the mortality rate was in the neighborhood of 15 per cent[27] To date, we have had no deaths within this period, and only one at the end of the fifth week. If this case is included the mortality is 3 7 per cent Many of our patients were bad risks from a medical standpoint It is important to emphasize that seldom were our patients excluded because of medical risk Unless the patient is so debilitated or his cardiorespiratory reserve is so poor that even with medical management he cannot tolerate anesthesia or an operation, there can be few medical contraindications to *surgery where there is a possibility of curing cancer*

The technique allows direct inspections of the tumor from below, through the trachea, and through the uninvolved pyriform sinus before neck dissection is attempted If the condition of the patient during the operation changes necessitating division of surgery into two stages this method is advantageous because at least the primary lesion has been removed If on the other hand neck dissection is done first, the primary would have to be removed at another operation The latter situation is worse because the lymphatic pathways will open directly into the neck wound In performing the radical neck dissection, the XIth and XIIth nerves are sacrificed if they are immediately adjacent to/or involved by questionable or positive nodes The nerve should be preserved whenever possible because shoulder drop and pain sometimes is very handicapping

Esophageal voice is possible in most instances and permanent pharyngeal fistula did not occur in any of our cases The cosmetic result, tracheal stoma and physiology is as good as in the one-stage radical procedure as for a laryngectomy alone

The authors are aware that it is still too early to evaluate this method of therapy on a five-year basis The fact remains that in consecutive cases a significant percentage of microscopic metastases has been demonstrated to exist in impalpable nodes This would suggest that if we are to improve the care rate, serious consideration should be given to routine prophylactic neck dissections with laryngectomy in those lesions where metastases are likely to occur

SUMMARY

1 The indication, limitations and technique for a one-stage *laryngectomy and radical neck dissection* are presented for the treatment of carcinoma of the larynx The method described allows a very wide excision of the primary lesion and of the cervical lymph nodes without cutting across the lymphatic pedicles

2 The time to treat advanced laryngeal carcinoma radically is at the first surgical excision

3 Laryngeal carcinoma arising on the aryepiglottic fold or pyriform sinus with secondary arytenoid or cordal involvement, or ventricular or false cord carcinoma extending into the pyriform sinus, or subglottic carcinoma with clinically positive nodes are ideally treated by this method

4 Prophylactic neck dissection is recommended for extensive primary lesions in the above rich lymphatic areas

5 Microscopically positive nodes were found in seven out of 18 prophylactic neck dissections (38 8 per cent) Six of the 15 occurred with subglottic and endolaryngeal carcinoma (40 per cent) This suggests that the cure rate may be improved if prophylactic neck dissections were done routinely in extensive laryngeal carcinomas

6 If a critical situation arises at the operation, the two stage operation may be done with removal of the primary lesions first A delayed neck dissection may be performed at a later date

7 The one-stage procedure described allows direct inspection of the tumor before removal of the nodes is attempted

8 The operative mortality rate in our series is slightly above that of laryngectomy alone.

9 Surgery is contraindicated in extensive anaplastic carcinoma with cervical metastases Roentgen therapy is advocated for this type of lesion Limited lesions showing anaplastic carcinoma are better treated with surgery followed by irradiation

10 Radical surgery *may* be used where irradiation has failed in extensive lesions

11 The cosmetic result, esophageal voice, and other functions appear as satisfactory as in a laryngectomy alone

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SYMPOSIUM
CARCINOMA OF THE LARYNX

I — CARCINOMA OF THE LARYNGOPHARYNX *†

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There was a time well within the memory of most of us, when even the mention of carcinoma of the laryngopharynx produced a mental reaction that is experienced only when one is confronted with a hopeless situation At present there are grounds for some optimism This optimism is based on available statistics that show not only an increasing salvage rate but also an increasing per cent of five-and 10-year arrested cases These better percentages are the direct result of improved surgical technique, a better understanding of the principles of radiation therapy and its limitations and, of prime importance, the increasing numbers of early diagnoses

The increasing number of early diagnoses is the direct result of a sustained, widespread program directed at the lay public as well as at all the practitioners of medicine and the general practitioners in particular All are cautioned to be on the alert for the early signs and symptoms of cancer It is true that such a program produces an unwanted amount of fear and hysteria It is also true that this is a low price to pay for the increased numbers of early diagnoses

The history of carcinoma of the laryngopharynx lends itself for division into three periods The first period is arbitrarily set in the second half of the nineteenth century Prior to the daring surgery of Czerny,[1] Kocher Mikulicz[3] von Hacker[4]

Read as part of a Symposium on Carcinoma of the Larynx at the meeting of the American College of Surgeons San Francisco Calif, Nov 8 1951

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and others, there were no even semisuccessful measures that were satisfactory for controlling or eliminating malignant neoplasms The site of the lesion made it inaccessible for topical medication The anatomy of the area and the proximity of vital structures prohibited the extensve use of escharotics and the actual cautery Even after these earlier workers demonstrated that some of the patients could and did survive the trauma of extensive surgery, the procedure did not meet with widespread acclaim The high mortality rate due to either infection or subsequent recurrence discouraged all but the most persistent surgeons This was neither acceptable to the average practitioner nor to most patients, who, although knowingly doomed, refused to submit to major surgery when it offered such a small hope for survival and less for cure Add to this their inadequate means for making an early diagnosis and it is evident why all but a few patients had extensive lesions and metastasis when they first presented themselves for consideration Under these conditions few surgeons were qualified to perform the required extensive surgery and fewer were willing to risk their position and reputation by operating upon these known unfavorable cases

The second period was initiated in the early 1920's and reached its peak some 15 years later The results obtained by treating cancer with fractional doses of radiation were striking The dissemination of this knowledge to both the lay and professional public made the name of Coutard a familiar one For a time, all but a few who persisted in directing their efforts toward refinements in surgical technique dropped their interest in surgery and directed their efforts and their patients to radiation therapy The whole idea of eradicating the cancer by a relatively unknown, almost mystical means, where in most instances there was no direct contact between the patient and source of the rays was and still is intriguing The advantage of high voltage over low voltage X-ray soon led to the production of super voltage sources and from there to multiples of super voltage It so happened that, being geographically placed as I am, and the fact that the "big" (60-inch) cyclotron of the late 1930's would permit directing a beam of neutrons to only the upper portion of the patient I had an opportunity to participate in the program of treating human malignancies with neutrons The additional factor that oral and laryngeal lesions are visible, permit detailed observation and are easily accessible for biopsies, made this type of patient an ideal one for study Unfortunately, the greater demands imposed upon the cyclotron and its personnel by unsettled world conditions necessitated a premature conclusion of this type of therapy and the cancellation of essential *in vivo* and *in vitro* experimental work For reasons well beyond my control, this work was not resumed following cessation of the actual war If this sounds a bit wistful it is because I cannot erase from my mind certain responses and reactions that took place during that relatively short period of employing neutron therapy It is hoped that the future will offer an opportunity to collaborate in a renewed program or that others will determine whether or not the neutron beam has more to offer than has been produced by X ray, radium or its substitutes

The third and present period dates back to the early 1940 s It shows a definite reversion to extensive and extended surgery as the treatment of choice Radiation therapy did have a fair and intelligently directed opportunity to show what it had to offer It has proved to be a valuable instrument it also has known limitations Certain of these limitations have been and can be controlled and handled better by direct surgical approach An outstanding example is the involved lymph nodes of the deep cervical area It is of little value to control or eradicate a primary lesion if the metastasis in the adjacent or distant lymph nodes do not respond in a similar manner

During the period that radiation therapy was enjoying popular acclaim surgery was far from dormant. Surgical techniques were improved Better organization and teamwork reduced both the time factor and the amount of tissue trauma Advances in anesthesiology produced better types of anesthesia with fewer operative and postoperative complications A better understanding of normal and abnormal human physiology indicated the necessity for attention to maintaining a normal fluid and electrolyte balance as well as a sufficient caloric intake The more common use of whole blood and its fractions and substitutes showed that by these means it was possible to obtain the high level of metabolic economy that is desirable and has not been obtained in any other way The acceptance of these facts and a more general realization that the patient is a biologic unit has forced the surgeon to maintain not only a high degree of technical skill, but also has imposed the additional duty of keeping up with the advances of modern physiology and medicine The benefits resulting from the applicaton of such knowledge for adequate and intelligent preoperative and postoperative care are proven

The advances in surgical technique and available means to avoid depletion of the patient's reserves would, of themselves, produce a marked drop in mortality per cents It so happened that during the same period radiation therapy was the accepted method of treatment, ways and means of controlling or eliminating existing and secondary infections were made available First, the chemotherapeutic agents, usually grouped under the term "sulfa," and then the antibiotic agents The large number of these agents and the wide bacterial spectrum they cover, either individually or in combinations, where they may act as individual agents or synergists, is such that there are few infections that cannot be controlled or eliminated With these thoughts in mind — improved surgical technique, a proper evaluation of the importance of the lymph nodes and lymphatic pathways of the head and neck, with means for their removal, a better knowledge of normal physiology, increased attention to the preoperative and postoperative care of the patient, and ways and means for controlling, combatting or eliminating infection — it is easy to account for the decrease in mortality rate from more than 50 per cent to less than 2 per cent, and the corresponding increase in survival rate for the accepted five-year period Add to these general statements the ever increasing bulk of statistics used to prove these statements, and it is evident that extended and extensive surgery has much to offer The word "radical" was purposely avoided Too often the limited, narrow field, so-called conservative procedures have proven to be inadequate Under these conditions the "conservative" measures are truly radical when compared with the more favorable results obtained by employing extensive, so-termed ' radical surgery "

It is fitting at this time, while thinking of statistics, to draw attention to those presented by one of our co-workers whose integrity is beyond question and whom I feel should be singled for special attention He initially equipped himself to pursue a somewhat distant specialty Soon after he had completed this training, he became interested in otolaryngology His training in soft tissue surgery, plus a period of training with Dr W Trotter in England gave him the necessary background experience and confidence to join and remain with the select few who carried on the work outlined by the pioneers in widefield and extensive surgery for the control and eradication of cancer of the laryngopharynx. A recent publication[5] presents a succinct summary of the laryngeal surgery this one individual has done Two tables show the results of slightly more than 25 years of his work. The figures are impressive and warrant detailed study by all who are interested in laryngology The total number of 344 cases with an operative mortality of 1 7 per cent and a high percentage of five-year cures is more than impressive Few of the centers and groups have produced larger numbers or better results than are offered by this one individual Many of the younger, and some not-so-young laryngologists are indebted to him for the time and effort he expended in helping them obtain proficiency in this work I feel that the record of Henry Boylan Orton warrants attention by all and commendation by those qualified to offer it

It would leave an unfair and biased impression if I failed to mention the role radiation therapy plays in this third and present period It is an important one, both in arrest palliation and in combination with surgery No single form of treatment has as yet presented a solution for the varied problems The interests of the patient are served best by those who have spent time and effort to learn the fundamentals of all types of treatment When this knowledge has been obtained, one is in a position to individualize the selection of treatment to that best suited for the particular patient under question Generalities have no place in the treatment of cancer, it is insidious and relentless Until such time as the etiology of cancer is available — until we understand why a cell or group of cells which have heretofore led a well regulated, communal existence, should suddenly change to a completely nonconformist one, there can be no single specific form of treatment Our present forms of treatment are based upon one or two principles mechanical removal of the cancer, with sufficient normal tissue to make certain that all cancer cells have been removed, or, kill it *in situ* and simultaneously destroy a complement of normal tissue cells All methods entail the sacrifice of varying amounts of normal tissue In this regard, adequate surgery is more extravagant than properly administered radiation therapy The surgical removal of the minimal amount of normal tissue often entails the extirpation of important structures or even entire organs This results in varying degrees of disability and discomfort in accord with the tissues removed The fact that most laryngectomized patients can learn to speak with an esophageal voice, and a goodly number do accomplish this feat, does not constitute complete rehabilitation, nor does the probability of attaining an esophageal voice detract from the value of a normally functioning, though possibly somewhat dry and telangiectatic larynx that may follow radiation therapy Similarly, the complete stenosis that may follow infection of a radiated larynx and which demands a permanent tracheotomy has offered the patient none of the benefits of a laryngectomy Such a larynx is a distinct hazard and should be removed These known results are presented on a comparative basis to remind us that all our present means of treatment are based upon removal or destruction of tissue and none can offer selective action of sufficient specificity to remove only the malignant cells Our backlog of experience and available statistics is sufficient to insist upon individualization in the selection of treatment that is best fitted for each particular case

It is time to present a plea for exerting more effort toward diagnosing cancer in its earlier phase All of you are confronted with the problem of the patient with carcinoma of the upper respiratory tract, and all of you are actively responsible for the future of these patients You are the one who *will influence the patient to make decisions as to selection of* type of treatment You all know that the best survival rates are obtained in the group of early diagnosed cases and that these better rates are obtained with a minimum loss of tissue and function It is your duty to devote time and effort in instructing all who will or must listen, to recognize the early signs and symptoms of malignancy It is likewise important that you, yourself, exert maximum care in the routine examination of your patients — especially those who have been under your care for a long period of time and whom you have come to know as friends as well as patients At some time one of their numerous complaints, too often taken lightly and for granted, may be based upon fact rather than fancy

In closing, I suggest that we all increase our efforts to obtain a constantly increasing number of early diagnoses of malignancy and that we individualize the selection of the method of treatment rather than follow any fixed routine If we are to derive real satisfaction from our work in this field let it be due to diminishing percentages of error and failures rather than *an increased total number of successes.*

CONCLUSIONS.

1. That until such time as the etiology of cancer has been established, there is little hope of finding a single, specific form of treatment.
2. Our present methods of treatment entail the removal or destruction of varying amounts of normal tissue in order to eliminate or arrest malignancy
3. The various accepted methods of therapy differ in mode of action and therefore, should be selected to fit the condition rather than to trying to make the patient fit the type of therapy
4. The earlier the malignancy is diagnosed, the less expensive its eradication This is true whether expressed in units of time tissue, function or dollars

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SYMPOSIUM

CARCINOMA OF THE LARYNX

II — CERVICAL METASTASIS

SURGICAL TREATMENT *

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San Francisco, Calif.

Introduction

The present trend of treatment of advanced extrinsic squamous cell carcinoma of the larynx is toward radical surgery. In recent years not only the larynx with its primary disease but also the cervical metastases as well have been excised in continuity in a one-stage operation, thus fulfilling the requirements of cancer surgery, namely, removal of the primary growth and metastases *en bloc*. As early as 1906, Crile[1] pointed out that the lymphatic system of the neck is a unique barrier in limiting the spread of cancer from the head and neck, and further describes surgical techniques for block dissection of the lymph bearing channels and nodes.

During recent years otorhinolaryngologists have accepted this form of therapy and are applying these surgical principles in the treatment of laryngeal cancer so that a patient with this disease has more chance of survival than ever before.

The purpose of this discussion is to review a series of patients with cancer of the larynx who have been treated surgically. Since this study covers only a five-year period, it appears more logical to study failure cases rather than successful cases in order to help answer the problem of what type of surgery should be employed for any given case. Experience has taught that this type of surgery cannot be stand

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*Read as part of a Symposium on Carcinoma of the Larynx at the meeting of the American College of Surgeons, San Francisco, Calif., Nov. 8, 1951.

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ardized, but that it must be flexible, adaptable and individualized This discussion, then, must be considered a preliminary report and only after a longer period of time can successful cases be evaluated

Analyses of Cases

During the past five years 75 cases with neoplasms of the larynx and hypopharynx have been observed Seventy-four of these cases were diagnosed microscopically as having squamous cell carcinoma, while the remaining one case was diagnosed microscopically as having myxosarcoma of the larynx For convenience, cases will be considered in the following categories

1 Advanced Cancer

Seventeen of the 74 cases presenting squamous cell carcinoma of the larynx or hypopharynx were considered too far advanced for any form of treatment on first examination This again emphasizes that many cases of carcinoma of the larynx and hypopharynx are still not being diagnosed early enough for therapy Several of these patients had inoperable primary lesions, several had "frozen necks," some had external fistulae, while still others had cervical metastases that were considered inoperable The only surgical procedures carried out in this group were laryngoscopy, biopsy and tracheotomy, when indicated As a whole this group of patients did not show generalized metastases The disease was localized to the structures of the neck and usually remained so until death or just prior to death Some of these patients received X-ray therapy as a palliative measure

2 X-ray Therapy

X-ray therapy was the recommended treatment in seven patients for the following reasons

1 Generalized systemic disease contraindicated surgery

2 Surgery was refused by the patient

3 In several patients with squamous cell carcinomas of the intrinsic larynx, this therapy was the treatment of choice

Two of the patients with small intrinsic carcinomas of the larynx that were treated by X-ray therapy subsequently required laryngectomy and will be considered under that category

3 Laryngofissure

The criteria established for laryngofissure have been rigid and only small squamous cell carcinomas occurring in the middle one-third of one vocal cord have been treated in this manner Eight patients underwent this operation Cervical metastases in this group of patients are unlikely and to date none of these patients has shown them One patient in this group died of carcinoma of the lung following laryngofissure The other seven are living and well

4 Widefield Laryngectomy

Thirty patients with extrinsic squamous cell carcinoma of the larynx were treated by widefield laryngectomy Two patients in this group subsequently had bloc dissection of the neck and will be considered later This leaves 28 patients to be considered here On admission none of these patients had demonstrable cervical metastases Seven patients in this group had had previous X-ray therapy varying from two months to seven years prior to the date of laryngectomy Laryngectomy has failed to arrest the cancer in seven of these patients Six of the patients have already died from cancer, while one patient is living with cancer and undoubtedly will soon succumb Primary locations of the neoplasms in these seven failure cases were as follows three lesions were sub glottic, two were of the epiglottis and two originated over the arytenoid area In spite of adequate follow-up examinations, a later surgical excision of the metastases was not possible for the following reasons

1 Metastasis of the cancer to the superior and inferior deep jugular lymph nodes was extremely rapid and the nodes were matted and bound down to adjacent structures

2 The spread of the cancer by direct continuity to the thyroid gland and the lymph nodes between the trachea and the esophagus was extensive

3 The direct spread of the cancer to adjacent soft tiss caused "frozen neck'

It is impossible to state whether any of these patients co have been treated successfully had prophylactic bloc dissecti of the neck been performed in conjunction with the prima widefield laryngectomy

5 *Widefield Laryngectomy or Widefield Laryngopharyngectomy Combined with Bloc Dissection*

The patients of primary concern to us are those who h cervical lymph node metastases on admission, those who veloped lymph node metastases during observation and th who would possibly develop them Fourteen patients can classified in these groups Six of these patients will be co sidered later, since four of them had bilateral bloc dissectio of the neck plus laryngectomy, while the other two had bl dissections of the neck following widefield laryngectomy Th leaves eight patients to be considered here On admission s of these patients with extrinsic squamous cell carcinoma the larynx and hypopharynx had palpable cervical lymph no metastases on the same side as the primary lesion In five these cases cancer bearing lymph nodes were found mic scopically in the surgical specimens, while in the sixth cas although there were cervical lymph nodes palpable, microscop cal examination of 29 nodes in the surgical specimen show no evidence of cancer, denoting that clinical palpation cann be relied upon exclusively to determine the presence of cance One patient with subglottic primary carcinoma and one p tient in whom the cancer involved the arytenoid area ha prophylactic bloc dissections of the neck in conjunction wit the widefield laryngectomy Although lymph nodes wer found in these latter two surgical specimens, there was n evidence of cancer within the lymph nodes examined mic scopically The primary site of the neoplasm in two othe patients was the pyriform sinus The remaining four patient of this group had primary lesions involving the true and fals cords, the aryepiglottic fold with infiltration of the neoplas has been one death in this group of eight patients and this patient died six months after the original surgery from un arrested cancer This patient had had a complete course of X-ray therapy seven years previously

6 *Widefield Laryngectomy and Bilateral Bloc Dissection*

These operations were carried out in two stages Widefield laryngectomy and bloc dissection of the neck were done in one stage, while the contralateral bloc dissection was done from five weeks to two years later There were four patients in this group On admission three of the patients had palpable lymph nodes on the same side of the neck as the primary laryngeal lesion, while the other patient had bilateral palpable lymph nodes In seven of the eight surgical specimens in these four patients, cancer was found in the lymph nodes microscopically One patient may be considered to have had a prophylactic bloc dissection of the neck following the appearance of a new neoplasm of the hypopharynx two years after the original operation, which was performed for an extrinsic submucosal squamous cell carcinoma of the false vocal cord with cervical lymph node metastases This patient is living and well three and one-half years following the original operation One patient is dead from cancer The other two patients are living with cancer and no doubt will soon succumb The primary lesion of the larynx in these latter three patients involved the true and false cords aryepiglottic fold with infiltration into the posterior inferior surface of the base of the epiglottis

7 *Bloc Dissection Following Widefield Laryngectomy*

There were two patients who had widefield laryngectomy and who later developed cervical metastases which were considered operable The interval between laryngectomy and bloc dissection varied from four to seven months in these two patients Here again the primary extrinsic lesions in both of these cases were found to involve the true and false cords the aryepiglottic fold with infiltration into the posterior inferior surface of the base of the epiglottis The primary lesions were apparently controlled by the widefield laryngectomy

Trimm Vacuum Tube Model No 300
Manufacturer Trimm Inc 400 Lake St (P O Box 489) Libertyville Ill

Unex Model "A Unex Midget Model 95, Unex Midget Model 110, Unex Models 200 and 300
Manufacturer Nichols & Clark Hathorne Mass

Vacolite Model J
Manufacturer Vacolite Co. 3003 N Henderson St. Dallas 6 Tex.

Western Electric Models 65 and 66
Manufacturer Audivox, Inc., successor to Western Electric Hearing Aid Division, 259 W 14th St. New York 11 N Y

Zenith Model 75, Zenith Miniature 75, Zenith Model Royal, Zenith Model Super Royal
Manufacturer Zenith Radio Corp 6001 Dickens Ave Chicago Ill

All of the accepted hearing devices employ vacuum tubes

Accepted Hearing Aids more than five years old have been omitted from this list for brevity

TABLE HEARING AIDS

Aurex (Semi Portable)
Manufacturer Aurex Corp 1117 N Franklin St. Chicago (10) Ill.

Precision Table Hearing Aid
Manufacturer Precision Hearing Aids 5157 W Grand Ave., Chicago 39 Ill.

Sonotone Professional Table Set Model 50
Manufacturer Sonotone Corp Elmsford N Y

All of the Accepted hearing devices employ vacuum tubes.

in situ," "to describe the expressions of faith by pathologists that a given segment of epithelium has undergone the initial stage of an irreversible sequence which can end only in frank invasive carcinoma." He believed it was impossible to foretell when invasion would begin[83] Bowen's first case did not *invade until after* a period of 19 years, yet Schuller's case required only seven years before invasion Willis, writing of further studies on the origin of carcinoma of skin, also refers to Bowen's disease, and states that the so-called precancerous dermatosis is now considered to be genuine carcinoma *in situ*.[84] Brighton and Altmann speak of superficial squamous epithelioma of Bowenoid type in reporting cases of intraepithelial spreading carcinoma of the upper respiratory and alimentary tracts[9] In recent years the many favorable references to Bowen's work can only signify recognition of the importance of his early contribution to the study of preinvasive cancer

In 1932 Broders emphasized that above everything else the microscopist must consider the character of the epithelial cells in order to arrive at a correct diagnosis He said that the day is past when epithelium can be considered nonmalignant because it has not penetrated the basement membrane, or malignant just because it is not confined within the basement membrane. In the latter sense he referred to benign penetrating epithelium in benign granulomatous ulcers such as in tuberculosis syphilis and actinomycosis. He said, "The diagnosis of carcinoma *in situ*, as of any carcinoma in general, is based chiefly on altered cellular characteristics *in contradistinction* to cellular situation' He described the nuclei of malignant cells, in contrast to those of normal cells, as having greater avidity for basophilic stains as usually increased in size both actually and as related to the cytoplasm, as frequently irregular not infrequently in a state of pathologic or atypical mitosis, and occasionally observed in groups in the form of tumor giant cells He believed carcinoma *in situ* may assume any type squamous, basal or adenocarcinoma, it may occur in any location in which carcinoma arises, and may be of any degree of malignancy He stated that in a biopsy of carcinoma with infiltration, the diagnosis will be easy, but if carcinoma *in situ* alone appears, it is necessary to recognize the malignant cell characteristics because the failure to do so is an error of omission fraught with grave danger to the patient[10]

Great credit must be given to Papanicolaou for his studies of cytology He writes that the idea of staining exfoliated cells was not new because Pouchet studied vaginal cells a hundred years earlier and Hampelon stained sputum 60 years ago As we have related, Papanicolaou became discouraged at his inability to interest clinicians in his cytological method of cancer diagnosis by vaginal smears, and returned to his previous work, however, in 1937, he became associated with Dr Herbert Traut in the study of cancer once again Vaginal smears were made routine in practically all gynecological patients in the Women's Clinic of the New York Hospital In a monograph in 1943, Papanicolaou and Traut reported studies of vaginal smears of 3,014 adult women There were 127 cases of carcinoma of the cervix and 52 cases of the fundus The cytological diagnosis by the vaginal smear technique failed in 3 2 per cent of the cervical and in 9 3 per cent of fundus cases They expressed the hope that cytological studies of smears from the cervical canal would be more accurate Later Papanicolaou reported that endocervical and endometrial smears reduced the chance of overlooking carcinoma of the cervix and endometrium[65 66 68]

Since the monograph of 1943, Papanicolaou's work has been confirmed by a number of other gynecological investigators[66] Fremont-Smith asserts that his group from Harvard was the first to corroborate Papanicolaou's cytological studies They wrote that biopsy is the best method of diagnosis, that there is exfoliation of cells from every epithelial surface of the body into the surrounding medium, that the cytological diagnosis of malignant tumors can be made on any cancer involving the free surface of any part of the body, that Meigs has presented evidence proving cytology theoretically sound, statistically reliable and superior at least in certain respects to biopsy Meigs showed that identical cells could be obtained by securing smears of malignant tumors at operations or from smears of body fluids of the patient bearing the tumor The diagnostic error of one group of 220 patients having 46 proven cancers was as low as 2.2 per cent.[31] There have also been rather numerous articles describing modifications of Papanicolaou's technique, and setting forth criteria of malignant cell characteristics[4, 35, 36, 40, 65]

The Papanicolaou technique depends upon immediate fixation of smears while still wet. Equal parts of absolute ethyl alcohol and ether is the preferred fixative. This method avoids the distortion that accompanies drying of cells[61] Staining technique accentuates nuclear detail, while maintaining cytoplasmic transparency Smears now are being made of any body secretion, or of centrifuged sediment of thin body fluids or washings of epithelial surfaces Sediment adheres to albumen covered slides, and fixation is carried out before drying can occur One advantage is technical simplicity, and Papanicolaou also points out that it is not very expensive or inconvenient to patients[63] There have been numerous reports of modifications of this technique,[5, 6, 36, 62, 73] although Hunter and Richardson maintain that the value of Papanicolaou's stain cannot be overemphasized.[40]

Papanicolaou affirmed that the diagnosis of cancer by cytological studies should be "based on strong, substantiative evidence offered by sufficient pathognomonic cells' and not merely on a few cells He maintains that negative or inconclusive tests should be repeated Among the advantages that he has described are *1* its simplicity and inexpensiveness, *2* its reliability in hands of experienced cytologists, *3* that it permits early recognition of hidden or incipient neoplasms such as carcinoma *in situ* by exfoliation before the onset of ulceration, *4* its suitability for a screening method on large numbers of patients, *5* that it is a valuable complement to biopsy or curettage because the cytological method covers a larger area *6* it may reveal carcinoma although biopsy may have failed and *7* it has unique value in following operative and radiologic treatment. On the other hand, this method does not indicate the grade of malignancy, does not supply information about metastatic activity or relationship to adjoining normal tissue, and the average time required for carefully studying a smear is longer than for a pathologic section The identification of carcinoma by the cytological method depends upon recognizing the characteristics of the malignant cells which are constantly being exfoliated from malignant neoplasms having a free surface [68]

The morphological character of malignant, yet not invasive, epithelium is characteristic and is so consistent that not infrequently a brief low power examination is all that is necessary to recognize its neoplastic nature Younge asserts that preinvasive carcinoma resembles the type of epithelium frequently found at the edge of an invading cancer [69] From his cytological studies Papanicolaou says that cancerous cells should show *1* Anisocytosis, *2* Anisokaryosis, *3* Hyperchromasia (abnormally densely stained karyosomes and nuclear membrane), and *4* abnormal mitotic figures [64] Reagan emphasizes that alterations in the appearance of the nuclear chromatin are the most important morphological feature in identification of the tumor cells, and that nuclear characteristics are important in differentiating cells derived from carcinoma *in situ* These nuclei are usually only slightly larger than the nuclei of the normal parabasal type cells of comparable size [72] Papanicolaou further describes his criteria for recognizing cancer cells as both cytological and histological This includes *1* variation in size of nuclei many of which are enlarged, both absolutely and relatively to the amount of cytoplasm, and *2* variation in shape of nuclei which also figure prominently in identification of tumor cells He includes other nuclear characteristics as abnormal clumping of chromatin, hyperchromasia, and enlargement of nucleoli Less reliable are cytoplasmic criteria, but frequently there will be vacuolization and at times cytoplasm will show engulfment of other cells [75] In spite of the apparent simplicity of recognizing cancer cells, there are numerous warnings that an experienced cytologist is absolutely necessary in this method of diagnosing carcinoma [31, 63, 72, 64]

After the cytological technique in the diagnosis of cancer of the female genital tract became well established, Papanicolaou says it was logical to attempt the same method in study of other systems[64 68,70] This has been used successfully in study of centrifuged sediment of prostatic secretions, urine, sputum, bronchial smears and washings, gastric content, gastric duodenal content and esophageal washings, laryngeal smears, nasopharyngeal smears, rectal mucus, acitic and other fluids. There are by now numerous reports of carcinoma *in situ* discovered on the basis of cytologic smears in various organs.[2,3 17 22 23 37 41 42,43 46 67 69 70 75,87 88]

There existed a reticence on the part of some pathologists to diagnose carcinoma without invasion[28 30,39] *Foote and* Stewart comment, 'This is hardly logical since it is so much more reasonable to conclude that if the tumor had not been a carcinoma prior to infiltration, then infiltration would not have occurred"[28] Moreover, various histogenetic studies link intraepithelial carcinoma with invasive carcinoma This is undoubtedly true in Bowen's disease and in carcinoma of the cervix.[52 73 74 81] Younge, commenting on Smith and Pemberton's cases reported in 1934, points out that five of the 16 cases were *not* diagnosed carcinoma *in situ* on the original biopsy but only on reviewing the original sections three and one-half to twelve and one-half years later when these patients began to develop invading carcinoma of the cervix. Younge describes two additional cases in which the original biopsies were considered benign, and reclassified only two to three years later when invading carcinoma developed[89] Pund and associates studied 1 200 surgically removed cervices They concluded that the preinvasive stage becomes invasive after a variable latency averaging five to six years, which seems to be the length of time required for endocervical carcinoma to develop sufficient penetration and ulceration of the vaginal surface of the cervix to become obvious.[71] Younge, Hertig and Armstrong describe an early case of carcinoma *in situ*, diagnosed by biopsy because healing would not follow cauterization of the cervix, and in which the carcinoma became invasive in 11 months[90] Hertig Sommers and Bengloff describe repeated biopsies on 11 patients showing sequential endometrial changes which advanced from carcinoma *in situ* to typical carcinoma[39] Black and Ackerman believe that qualified, independent investigators,who have described about 30 cases, have well documented evidence that carcinoma *in situ* of the cervix has been followed by invasive carcinoma[6] Black and Ackerman have studied epidermoid carcinoma *in situ* of the bronchi and lungs and concluded that "evidence has accumulated that epidermoid and undifferentiated tumors of the major bronchi may arise first as islands of carcinoma *in situ*" They describe the initial phase as a progressive metaplasia of the surface epithelium with cellular hyperactivity in the basal layer, increased mitotic activity of the basal layer produces packing of nuclei, increased stratification, and thickening of the epithelium, mitotic activity increase as the basal cell activity extends closer to the surface Finally all layers are involved, and the ciliated superficial layer no longer is present Preinvasive carcinoma of the bronchus is present with the changes extending through all layers to the surface from the intact basement membrane They reviewed 60 recent pneumonectomy cases and found that in 35 per cent of these either marked anaplasia of intact epithelium or frank carcinoma *in situ* was closely adjacent to invasive carcinoma[6] There seems little reason to doubt that preinvasive carcinoma, if uninterrupted by effective treatment, will eventually cause the death of the host[32]

The laryngeal epithelium may undergo the same type of progressive cellular alteration as occurs in the uterine cervix with the development of increasing activity in the basal layer, increased mitotic activity, packing of nuclei, increased stratification, and development of carcinoma *in situ*,[1] therefore, it should be possible to discover carcinoma of the larynx in the preinvasive stage when the best chance for cure exists

Such reports are beginning to appear in the otolaryngologic literature Clerf reported an unusual case of carcinoma of the larynx diagnosed by Mackenty in 1927 Laryngectomy was refused until 1938 when it was performed by Clerf After review of the tissue and original biopsy by another pathologist, it was thought that this might have been a case of "Bowen's disease of the larynx."[14] Brighton and Altmann reported six cases of carcinoma *in situ* from the upper respiratory and alimentary tracts There were two cases from the larynx and one each from nasal septal mucosa, tonsil, oral mucosa and pharyngeal mucosa[9] Snitman advocated serial section of all removed laryngofissure masses to avoid incomplete removal of tumor, and to find previously unrecognized tumor He reports a case with carcinoma completely removed from the anterior and middle thirds of the left cord, but with carcinoma *in situ* in the anterior portion of the right cord[76] Gordon found carcinoma *in situ* underlying keratosis of the larynx[34] Brunner has reported a case of superficial epidermoid carcinoma of the larynx associated with trichinosis of laryngeal muscles[11] For several years Papanicolaou's technique has been employed by Siebert for studying laryngeal and nasopharyngeal smears[60] Bryan and Bryan, who at first utilized Papanicolaou stains to study epithelial cells during upper respiratory infections,[12] since have studied many smears from various areas of the upper alimentary and respiratory tracts[13] Their reports have been of great help in diagnosing malignant neoplasms, and in evaluating the results of irradiation treatment. Schoolman advocates both biopsy and cytologic smears from the nasopharynx in order that the value of the Papanicolaou technique in this area may be determined[77] Such developments indicate that earlier recognition of otolaryngological malignancies may be expected In hope of stimulating interest in problems associated with carcinoma *in situ* in otolaryngology, the following cases are described

CASE REPORTS.

Case 1 L. M M. a 27 year-old single white female laboratory technician, a private patient complained of slight hoarseness for about six months when first seen in October 1948. She was worried about cancer She had a quiescent compensated rheumatic heart and normal blood pressure. Physical examination otherwise was entirely normal except for the presence of two very small, smooth laryngeal nodules one on the free edge of each vocal cord at approximately the junction of the anterior and middle thirds These nodules were in contact on phonation The color of the cords was a normal pearly white and that of the nodules was a flat light gray There was no redness surrounding the nodules

She entered McMillan Hospital Oct 19, 1948 The nodules were
moved the following morning without difficulty by the suspension meth
using laryngeal cup forceps The nodule on the left cord was minute, a
the larger nodule on the right cord was about the size of the head o
common pin There was no clinical suggestion of malignancy Becau
of the possibility of papilloma, the denuded areas of mucous membra
were carefully touched with a very small amount of 25 per cent sil
nitrate solution on a laryngeal applicator

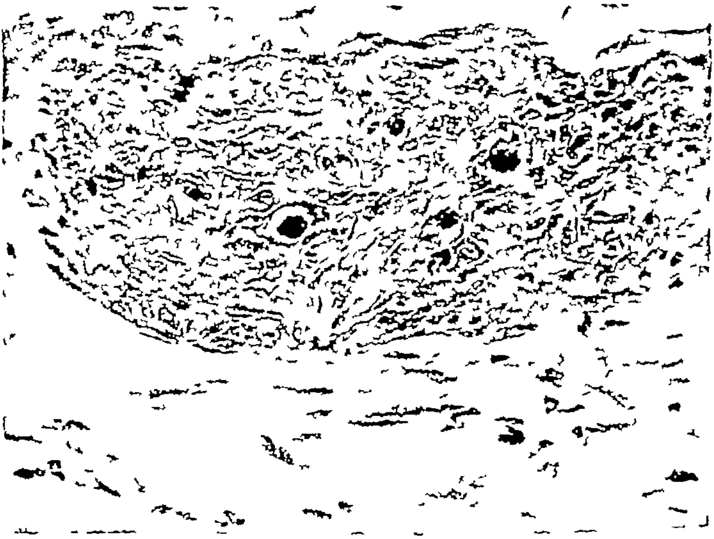

Fig 1 Case 1 L M. M Carcinoma in situ of left vocal cord Oct 20 19
300×

We were concerned, indeed, the following day to receive a diagnosis
carcinoma *in situ* of both cords by Dr Parker A Beamer of the Wa
ington University Pathology Department This diagnosis was confirm
also by Dr Lauren Ackerman and Dr Robert A Moore

The specimens consisted of three pieces from the left cord, the larg
of which measured 2 x 1 5 x 0 5 mm and two pieces from the right, t
larger of which was 3 x 2 x 2 mm The squamous epithelium bilatera
showed disarrangement of its structure There were large cells, many
which showed mitotic figures and tended to arrange themselves perp
dicularly to the surface There was no invasion below the baseme
membrane There seemed to be no doubt that carcinoma *in situ* w
bilateral

She was presented at the weekly conference of the Department
Otolaryngology, Washington University, for therapeutic recommendatio
Diathermy excision under suspension laryngoscopy as advocated by
Gordon New was considered Dr Ackerman felt that a curative dose
X radiation could be recommended on the basis of the pathologic c
changes, however, because of her hospital association and availabil
for daily laryngeal study, it was decided to keep her under the clos

observation, to rebiopsy if any suggestion of a recurrence could be seen and to defer any specific treatment at that time. Her larynx healed nicely Daily laryngeal examinations gradually became weekly then every two weeks, then monthly Her voice is good. There has never been any suggestion of recurrence On one or two occasions she has been slightly hoarse for a few days during a head cold. She remains under regular observation.

This case clearly illustrates the necessity for careful pathological study of even the most minute laryngeal specimen. It also demonstrates the feasibility of close observation of the larynx for evidence of recurrence because of its accessibility If recurrence is ever suggested immediate *cytologic* and histologic studies will be indicated If cancer cells are found, an adequate type of treatment must be instituted without delay

Case 2 G L. P., a 54-year-old white male private patient a masseur complained of intermittent huskiness for about three years, which had been worse with colds. There was no history of weight loss, cough, or loss of appetite or strength. He was a moderate cigarette smoker When first seen in April 1950 he was slightly hoarse There was moderate diffuse chronic thickening of both true cords which were dull gray The laryngeal appearance suggested hyperkeratosis. In addition the left cord presented a slightly yellow area, 3 to 5 mm in diameter on its superior surface near the vocal process, and a small gray nodule on the free edge near the junction of the anterior and middle thirds The epithelium of the right true cord was similarly and uniformly thickened General physical condition was good. Blood pressure was 120/70 A chest film was negative.

He was admitted to McMillan Hospital. The following day April 15 1950 suspension laryngoscopy was uneventful The thickened membrane stripped easily from the right cord, and was removed in four pieces from the left cord with laryngeal cup forceps. There was minimal postoperative discomfort.

The pathological diagnosis was hyperplasia on the right and carcinoma *in situ* on the left. Two pieces from the left cord showed thickened but otherwise normal epithelium with edema of the stroma The other two pieces were described by Dr Edward H. Smith of the Washington University Department of Pathology as showing "very interesting epithelium with thick parakeratotic corneum and acanthotic underlying prickle cell zone. The latter zone forms wide rounded rete pegs in which two abortive epithelial pearls and several mitotic figures are found One mitotic figure is atypical. The basal layer is intact in every sector

His larynx was watched carefully during healing. The cords regained a fairly normal appearance and his voice was good. Approximately four months later he developed a fever and cough This apparently was due to a second malignancy developing very rapidly in the right hilar region. He would not consent to endoscopic examination until late in October 1950 At bronchoscopy the tumor was not accessible and the vocal cords remained entirely normal in appearance. Exploratory thoracotomy elsewhere revealed adenocarcinoma.

This case history illustrates the almost simultaneous development of distinctly different, primary malignant tumors in the same patient, the laryngeal being of squamous cell origin and the bronchogenic tumor showing adenocarcinoma. This man did not survive sufficiently long after the removal of his laryngeal carcinoma *in situ* for any conclusions to be drawn about the tendency of the laryngeal tumor to recur This patient is one of many in various fields of medicine who have been shown in recent years to have developed distinctly different and secondary primary malignancies

Case 3 M S B, a 58 year old white male, a grocery clerk, was admitted to the Washington University Otolaryngology Clinic with a 15-year history of hoarseness, which had been worse for three or four years.

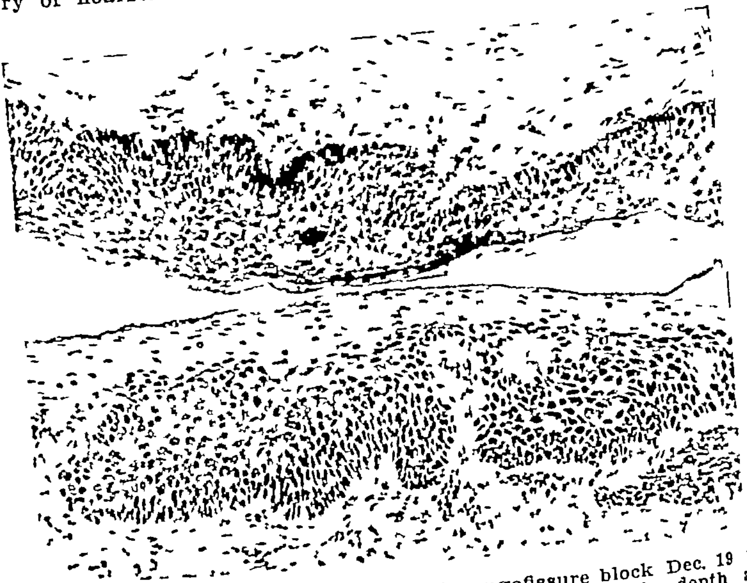

Fig 2 Case 3 M S B Sections from laryngofissure block Dec. 19 1950 Epithelial layer above showing changes throughout its entire depth adjacent epithelial layer below demonstrating marked basal layer changes approaching the surface basement membrane remains intact

There was a small laryngeal nodule projecting medially from the middle third of the right true cord This was smooth There was no ulceration The nodule was in contact with the left cord on phonation His blood pressure was 210/110 and there was moderate cardiac enlargement.

Oct 25, 1950, the laryngeal nodule was removed at McMillan Hospital and showed epidermoid carcinoma *in situ* Rebiopsy of the right cord was done Dec 5 1950, and the report again was carcinoma *in situ* Anaplasia and hyperchromasia in the epithelium was confined within the basement membrane There were a few broad papillae extending into the stroma. On Dec 19, 1950 a right laryngofissure was done Noninvasive carcinoma was present in several areas of the surgical specimen There has been no apparent recurrence to this time

This case is included in this report through the courtesy of Dr J Ogura, Dr J West and Dr L Gurnee and illustrates the occurrence of carcinoma *in situ* of a laryngeal nodule and of that side of the larynx in a patient whose hoarseness had existed for at least 15 years This preinvasive cancer was eradicated by adequate treatment.

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Case 4 A. M., 78-year-old white male, proprietor of a barber shop private patient of Dr M. F Arbuckle, through whose courtesy this case is described was admitted to McMillan Hospital June 2 1948 for laryngeal biopsy because of fusiform red thickening of the right true cord Hoarseness was first noted seven months earlier after he had strained his voice in public speaking. Hoarseness had not been constant but was noted if he talked for any length of time. General physical condition was good Blood pressure was 150/90 He had suffered some previous anginal symptoms. Electrocardiogram was normal Several biopsy specimens were taken through the anterior commissure laryngoscope. The clinical appearance was not very suggestive of malignancy Three pieces of tissue were described as soft, pinkish or grayish. The largest specimen was 4 x 3 x 2 mm. The pathological description included fibrous tissue linked by respiratory and metaplastic epithelium an intact basement membrane areas of hemorrhage in the fibrous tissue, and large deeply pigmented cells. Nothing in the report suggested that the sections had presented any special diagnostic pathologic problem. The diagnosis was "laryngeal nodule."

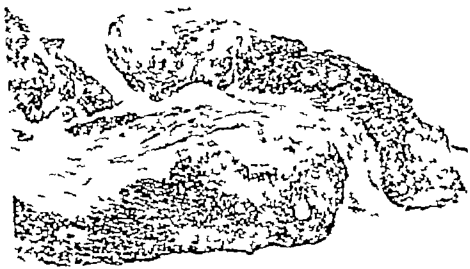

Fig 3. Case 4 A. M. Original biopsy of right true cord, June 2 1948 Epithelium was described as metaplastic. Diagnosis of carcinoma in situ was made on review by another *pathologist* 15 months later after frank invasive carcinoma was almost beyond the limit for laryngofissure Failure to consider original biopsy tissue malignant was an "error of omission fraught with danger" to this patient. 85X

Hoarseness continued. In September 1949 he again consulted Dr Arbuckle, saying that for the last five or six weeks his voice had been worse and that talking was painful at times. The right true cord was red thickened, with an elevated, definite malignant appearing lesion His general physical condition was relatively good He could walk seven or eight blocks without discomfort. Blood pressure was 166/88 Dr Edward B. Smith and Dr Lauren Ackerman who had not seen the original slides, were asked to review these sections. It was their opinion that carcinoma *in situ* was present in the first biopsy 15 months earlier

Multiple biopsies were taken by Dr Arbuckle from the right true cord on Sept 21, 1949 The lesion extended from the anterior commissure almost to the vocal process The cord was not fixed, the other cord appeared normal Dr Smith described this tissue as having a basement membrane not always intact, epithelial cells migrating into the stroma in an irregular manner, detached cords, sheets and strands deep in the stroma, showing in some places small epithelial pearly formations The cells in general showed irregular and hyperchromatic nuclei with intercellular bridging The diagnosis was epidermoid carcinoma, grade II.

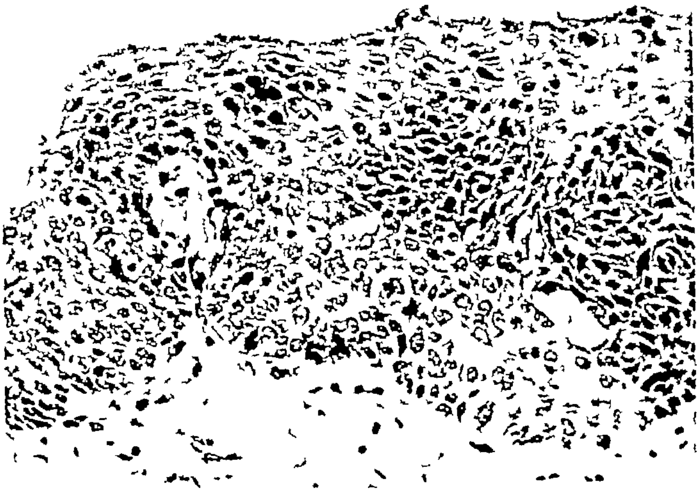

Fig 4 Case 4 A. M Biopsy of right true cord Sept. 21 1949 showing invasive carcinoma Review of original biopsy proves that preinvasive carcinoma or carcinoma in situ existed in June 1948 Preinvasive carcinoma has progressed in this larynx to frankly invasive cancer in 15 months. 255×

Laryngofissure was performed on Sept 26, 1949 Three or 4 mm of the opposite cord were removed with the right laryngofissure block because of possible extension across the anterior commissure Pathologic study showed a 3 mm margin anteriorly Laterally the tumor had deeply invading pegs of moderately large cells extending to within a few millimeters of the periochondrial boundary There was a moderate number of mitotic figures He recovered satisfactorily and is still free from laryngeal symptoms or signs of recurrence

This case illustrates the error of omission in failing to diagnose carcinoma *in situ* on original biopsy — an 'error fraught with danger to the patient," as pointed out by Broders in 1932 It also proves that preinvasive carcinoma of the larynx became frankly invasive, and was, therefore, cancer 15 months earlier at the time of original biopsy

Case 5 L H, 38-year-old white male a farmer, was admitted to the Veterans Administration Hospital, Jefferson Barracks, Mo, on Oct. 30, 1950 because of backache which had been present since his wartime army service He had thoracic kyphosis and scoliosis, and walked with a poker back. Also there were palpable discrete nodes in the right side of the neck. He was seen in consultation by the otolaryngology service Search for a cause of the adenopathy revealed a small nodular white mass of tissue in the right glossoepiglottic fold Tissue was removed from this area for microscopic diagnosis on Nov 4 1950 Sections showed typical carcinoma *in situ* however, additional tissue was requested by Dr Franz Leidler and Dr Lauren Ackerman, pathologists both of whom suggested that carcinoma may be originating in mulitple

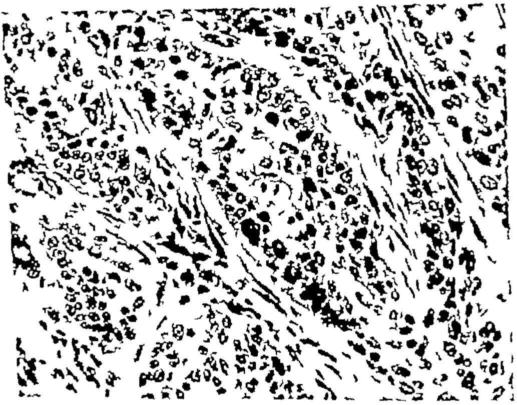

Fig 5 Case 4 A. M. Tissue removed at laryngofissure, Sept. 26, 1949 showing invasive epidermoid carcinoma. ×55×

foci as is common especially about the oral cavity and that this carcinoma *in situ* probably was closely adjacent to invasive carcinoma or that it was actually the advancing edge of a frankly invasive cancer On the second biopsy typical invasive carcinoma was found within a centimeter of the original biopsy

This is an illustration that the *possibility* of inaccurate diagnosis of preinvasive carcinoma must be avoided by great care Consultation of clinical and laboratory physicians minimize such dangers as incomplete or improper diagnoses.

SUMMARY AND CONCLUSIONS

Carcinoma *in situ,* intraepithelial carcinoma or preinvasive carcinoma is the earliest form of recognizable cancer This is the initial microscopic, irreversible morphologic change in tissues which *eventually* will kill the host if not controlled by adequate therapy Alterations in cellular structure and arrangement are unquestionably neoplastic, but the essential factor of invasion is absent The lack of penetration and the intact basement membrane have been potent deterrents in acceptance of the idea that early cancer can be diagnosed in the absence of infiltration The preinvasive characterization infers the invasive potentiality which changes early cancer into advanced cancer

Diagnosis of carcinoma without invasion depends upon recognition of the characteristics of cancer cells Histologic and cytologic studies of cancer cells have been narrated Cases of preinvasive carcinoma progressing to invasive cancer have been recounted Knowledge of cellular changes and their potentialities clarify the concept that carcinoma *in situ* is malignant and requires courageous, prompt treatment to eradicate cancer in the early stage

Preinvasive carcinoma is clinically invisible More frequent biopsies and greater use of exfoliative cytology are making carcinoma *in situ* relatively commonplace Until a better method is available for early diagnosis, reliance must be placed on constant vigilance, unrepressed suspicion, more biopsies and cytologic studies, and the collaboration of an experienced pathologist

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This paper was reviewed in the VA and published with the approval of the Chief Medical Director The statements and conclusions published by the author are the result of his own studies and do not necessarily reflect the opinion or policy of the VA

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SECRETORY OTITIS MEDIA *

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Secretory otitis media is one of the most important and often most perplexing otologic problems in office practice today, although it has not received the attention it deserves

The purpose of this paper is to review the literature, both old and recent, to discuss and attempt to evaluate certain aspects of the condition with particular interest in etiology, pathology and treatment, and to record some of my observations on 372 patients with acute, subacute and chronic secretory otitis media seen in private practice during a five and one-half year period from January, 1946, to July, 1951, inclusive

The term secretory otitis media, as used in this discussion, is intended to include all patients who present themselves with an accumulation of serous or mucus (nonpurulent) fluid in the middle ear and usually the mastoid cavity as well Synonyms include otitis media with effusion, serous otitis media, catarrh of the middle ear, tympanic hydrops, tubo-tympanic catarrh, etc As Hoople[1] has pointed out, none of these terms by itself is adequately descriptive of this disease from an etiologic or pathologic standpoint "Secretory otitis media" implies a true glandular secretory activity on the part of the mucosa but this is probably minimal or even absent in most cases, as will be brought out later The term "otitis media with effusion" implies that an inflammatory process is involved, which also does not hold true in all cases For want of a better term, however, these two will be used synonymously in this paper

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SCHEDULE OF SECTIONAL MEETINGS—1952

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El Panama Hotel Panama City R. P Wednesday Thursday Friday January 16 17 18

Hotel Adolphus Dallas Tex Monday Tuesday Wednesday February 4 5 6

Chalfonte-Haddon Hall Atlantic City N J Monday Tuesday February 11 12

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The Radisson Hotel Minneapolis Minn. Monday Tuesday Wednesday March 24 25 26

The Vancouver Hotel Vancouver B C Monday Tuesday Wednesday March 31 April 1 2

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HISTORICAL NOTE

Many of us tend to look upon this condition as a new entity because our own experience with it is relatively recent, but upon reviewing the older literature we may well be amazed to find that Politzer described it in accurate detail in 1869 and devoted 20 pages to it in the fifth edition of his book in 1909 Little has been added to our knowledge of this condition except in the fields of chemistry and allergy, and perhaps concerning the influence of the autonomic nervous system upon capillary permeability

In 1906, Kyle[3] also discussed the treatment of catarrh of the middle ear and approved the practice of myringotomy and inflation. Some others[4] at this time were advocating the use of such measures as medicated vapors and superheated compressed air insufflated into the Eustachian tube Ballenger,[5] in 1908 gave a good description of the *mucus type of acute otitis* media, as did also Phillips[6] (1919) and Kerrison (1923) in their respective textbooks

Then followed a period during which the teachings of Politzer were either forgotten or ignored and fluid in the middle ear received little attention. With the exception of an excellent case report in 1927 by Lawson,[8] no clinical papers on *otitis media* with effusion appeared in the American literature until 1940 The subject of acute catarrhal otitis media had been well covered in most of the textbooks, but little had been said concerning chronic *otitis media* with effusion until recent years after interest in this subject had been restimulated by Jones,[9] Hoople and Blaisdell,[10] Hantman,[11] Robison[12], and others

There is still a great deal of confusion and uncertainty concerning the etiology and pathogenesis in many of the chronic cases. As one observes and treats these patients over a period of years there are certain questions that arise. Among those that have occurred to me some of which have been proposed by others are these

1 Why do some individuals with an obstructed Eustachian tube and retracted drum develop an accumulation of fluid in the middle ear while others do not?

2 Why do some cases become chronic with little or no evidence of pathology in the nose, sinuses, nasopharynx or Eustachian orifice?

3 Why do some continue to have fluid in the tympanum in the presence of an apparently open Eustachian tube?

4 Why do the majority of reports of large series of cases come from otolaryngologists practicing in coastal areas and river valleys, or in other words, is the incidence of secretory otitis media influenced by altitude and humidity, or either of them?

5 Does determination of the protein content of the fluid have any practical value? Can one determine the origin of the fluid by determining the protein content, and is there any correlation between protein content and cytology of the fluid?

6 Are eosinophiles commonly found in the ear fluid when the tubal obstruction is the result of allergy?

The author has not found the answers to all these questions during the course of this study but has satisfied his curiosity with regard to some of them

PATHOGENESIS

Sterile fluid in the middle ear apparently may occur as the result of one or both of two pathological processes

It may occur as an effusion resulting from the action of negative pressure on the thin walled arterioles and capillaries in the mucosa of the middle ear, the vacuum of course being the result of Eustachian tube obstruction ascribable to one of many possible causes Transudation due to a vacuum alone occurs in the purest form in aero-otitis media, which Hantman[11] refers to as a "hyperacute" secretory otitis media

Secondly, it is said that fluid may occur as a response to low grade inflammatory reaction in the mucosa of the Eustachian tube and tympanum, secondary to infection in the nose or throat, in which case it is an exudate, but free of bacteria

In many cases the fluid is a result of both these influences, that is, a mixture of transudate and exudate with varying amounts of each

ANATOMICAL CONSIDERATIONS

A review of the anatomy and histology of the Eustachian tube and tympanic cavity brings to one's attention several facts which may be of interest in the pathogenesis of this disease

1 Eggston and Wolff[13] found that great *variations in the* size of the isthmus of the tube exist even in individuals of the same age This may be one reason why some people develop tubal obstruction and effusion more readily than others under similar circumstances

2 These authors state further that under normal conditions the tympanic mucosa consists of low cuboidal epithelium and the submucosa is often just thick enough to transport the relatively small blood vessels, nerves and lymph channels.

3 Eggston and Wolff have noted also that "the arteriolar walls are very delicate and frequently one can observe blood corpuscles in the act of escaping from the vascular channels at the time of fixation of the tissues"

Keeping the above facts in mind, one can readily see that the histologic structure of the middle ear is ideal for the effusion of serum in the presence of a vacuum, however, according to these same authorities, the mucosa is subject to abrupt and marked changes under apparently slight stimulus," and by a combination of edema and actual multiplication of cells it may become several times its normal thickness.

The variability in the thickness of the mucosa and differences in capillary permeability are possible explanations why some middle ears develop an effusion and others do not.

The origin of the serous fluid in this disease is undoubtedly from transudation of fluid elements of blood serum through the thin walled arterioles and capillaries in the submucosa of the tympanic and mastoid cavities, but the origin of the "mucus type" fluid warrants more discussion Politzer[*] and others have stated that it is the mucosal response to inflammation, but if the mucosa contains no secreting acinous glands one may wonder about the "secretory" origin of the fluid Lowy,[14] too, was particularly concerned with the origin of the exudate He believed that it must, of course, originate in the vessels, but was interested in determining if the cellular elements of the mucosa play an active part, that is, whether a true secretory process is involved He proceeded on the premise that a secretory activity on the part of the epithelium should produce changes in the constituents of the serum and, on the other hand, if only an increase in permeability is involved, the exudate should retain the essential characteristics of the blood serum He was able to demonstrate the identity of the blood group (type) in the middle ear exudate in each of 15 cases examined, whereas this proved impossible in the exudate of cases with suppurating otitis He also proved by biopsy of the middle ear mucosa in a child with secretory catarrh (who had died of other causes) that severe mucosal edema existed His conclusions were that a simple increase in the permeability of the capillaries favors the development of a serous otitis media and that his investigations do not indicate an active secretory activity on the part of the mucosal epithelium

Lawson[8] states that "the mucus in the mucus type of the disease comes as a result of the closure of the Eustachian tube It is the normal secretion of the mucous glands within the tube and may be increased temporarily to balance the external atmospheric pressure"

The presence of the mucus (not serum) in the middle ear, therefore, may be explained in one or both of two possible ways *1* because of blockage of the tube at its pharyngeal end, mucus secreted by acinous glands in the pharyngeal portion of the tube may have made its way by retrograde flow into the tympanum, 2 it may have been secreted by newly formed goblet cells in the tympanum Quoting from Eggston and Wolff,[11] ' No glands are present in the submucosa of the middle ear Normally not even goblet cells are evident in the mucosa but in the presence of infection they may occur How this tissue is kept moist is not known "

The evidence, then favors the view that most of the fluid originates in the blood serum under the influence of negative pressure alone or by the added influence of inflammation and increased capillary permeability It may be added to or replaced in some cases by the secretion of mucus by acinous glands in the Eustachian tube and by the goblet cells in the tube and tympanic cavity The secretion by goblet cells in a metaplastic mucosa may explain the persistence of fluid in some ears after the Eustachian tube has become patent.

ETIOLOGY

As has been mentioned in the preceding paragraphs, the primary factor in the etiology (of otitis media with effusion) is an obstructed Eustachian tube Any condition which is capable of producing swelling of the tubal mucosa, compression of the ostium or lumen of the tube or in any way interfering with the normal tubal function must be considered a possible etiologic factor Robison[1] is of the opinion that the obstruction is often due to mechanical lymphatic blockage secondary to inflammatory swelling of the lateral retropharyngeal lymph nodes which drain the sinuses and naso pharynx as well as the middle ear, resulting in retrograde lymph circulation and lymphedema of the tubal mucosa at the isthmus

In addition to upper respiratory infections and lymphoid hyperplasias there are many other local conditions which may be causative or predisposing factors. Allergy is an important and probably often overlooked cause, but on the other hand, we must be careful not to assume an allergic etiology merely because there is no other immediately obvious pathology Dental malocclusion, tumors of the nasopharynx, and paralysis of the tensor veli palatini muscle account for a small percentage of cases each Marked septal deviations and cleft palate are predisposing factors

Some of these patients have probably had a long standing partial obstruction of the tube because of a traumatic adenoidectomy or a previous suppurative otitis media They tend to have a recurrence of serous effusion into the tympanum with each upper respiratory infection

Most of us who have been disappointed with the results of our treatment have suspected for some time that obstruction of the Eustachian tube is not the only factor in the persistence of effusion into the middle ear What else, then, may play a rôle in the persistence of the fluid? Hoople[1] has mentioned systemic conditions which abnormally affect tissue fluid balance namely, allergy, cardiac insufficiency, cardiovascular renal disease, and endocrine disturbances as potential sources of trouble, particularly in persistent chronic cases These diseases probably affect the water balance by increasing the capillary permeability Other conditions which increase capillary permeability may be important primary or secondary causes of effusion in the middle ear Hilger[15] has pointed out that autonomic dysfunction, which is sometimes the result of psychic disturbance, may result in arteriolar spasm and capillary dilatation Williams[16] has recently discussed the relationship of autonomic dysfunction to allergy In an extensive review of the literature, he points out that anoxia in the involved tissue leads to increased capillary permeability and that "destruction of the leucocytes in the capillary loop together with more or less injury of other involved cells would result in the release of histamine, which also would increase capillary permeability " It seems reasonable that these effects of autonomic dysfunction could occur also in the middle ear and favor the continuance of an effusion in some cases

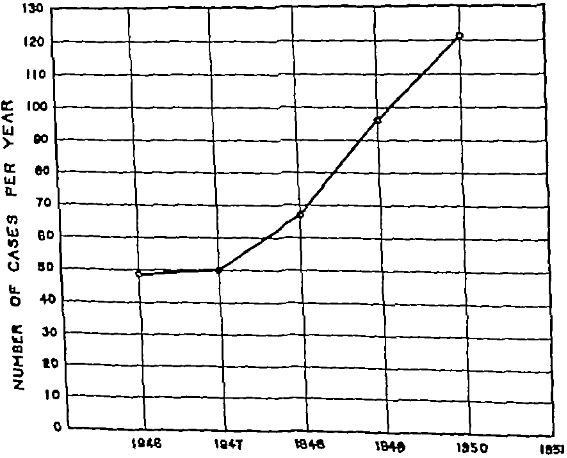
INCIDENCE

I — Increasing in frequency?

That there has been an increase in the incidence of otitis media with effusion since 1940 is generally believed to be true, but the reasons for the increase have not been agreed upon by various authors The theories advanced to explain the greater incidence are as follows

1 *Increased vigilance* on the part of otolaryngologists, once they have learned to recognize the condition, is believed to be the chief factor by Hoople[1] and also by Jordan[17] This has certainly been true in my experience as shown by the accompanying Chart 1 Prior to service in the Army, the author recognized very few cases and since 1946 has observed a steady increase in incidence chiefly because he has looked for the disease

CHART #1



INCIDENCE BY YEARS (1946 – 1950 INCL.)
382 CASES IN 324 PATIENTS

2 *Virus infection* Eagle[18] and others are of the opinion that many of these cases are due to viral infections in the

middle ear The fact that the fluid is found sterile by ordinary culture methods does not, of course, preclude the possibility of a virus infection Viruses inhabit tissue cells and are not found in the intercellular spaces or tissue fluids Lawson,[8] while discussing the possible reasons for the sterile condition of the fluid, included the possibility that the investigative methods may be insufficient, that the organism may be ultra microscopic, and further that the organisms may be in the mucosa but not in the exudate Although Lawson did not mention the term "virus," all these criteria would hold true for a virus infection Further investigation is needed to prove or disprove this theory

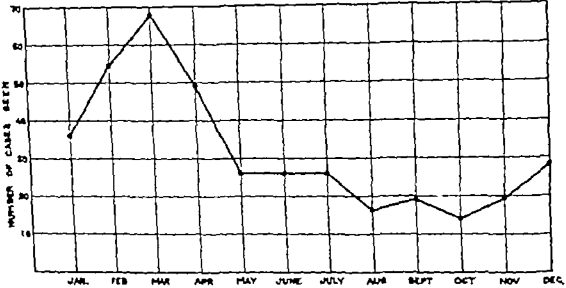
3 Hypovirulent infections due to increasing use of antibiotics and chemotherapy are believed by Hall[19] to be the cause of the increasing frequency Lawson[8] and Lederer[20] also refer to hypovirulent infection as a possible factor in the etiology of this disease Hoople[1] has noted only a 20 per cent increase in the incidence of fluid in the ear since the advent of chemotherapy, most of the increase being found in children Many of the cases of mucus otitis media seen in children undoubtedly represent aborted acute otitis media that would have become suppurative had they not received antibiotics There are those, however, with mucus otitis media who have not received any medication

II — Influence of Climate

1 Temperature in itself is not believed to be an important factor except that the condition occurs most frequently in seasons of the year when the temperature is most variable and hence when upper respiratory infections are most prevalent In the author's locality the largest number of cases were observed during the months of February, March and April (as shown in Chart 2), which happen to be months of extremely variable temperature This has been observed also by others

2 Altitude and humidity were first mentioned by Politzer,[3] and later by Ballenger,[5] Eagle[18] and Hantman,[11] as being possible influencing factors in the incidence of this disease Their importance has been questioned by others While reviewing the literature for this thesis the author was impressed by the fact that most reports of large series of cases came from otolaryngologists residing in coastal areas and along river valleys where the altitude is relatively low and the humidity high. Well qualified otolaryngologists residing in localities where the reverse conditions of altitude and humidity prevail were questioned regarding the incidence of secretory otitis media and their responses with one exception (Boulder) were to the effect that even though they were on the alert for such cases they saw only a few per month or a few per year

CHART #2



INCIDENCE BY MONTHS FOR 5 YEAR PERIOD
(1946 – 1950 INCL.)
382 CASES IN 324 PATIENTS

Localities of reported high and low incidence with their respective ground elevations and relative average humidities are shown in Table 1 It is admitted that this survey is incomplete, but it seems reasonable to assume that an individual with pre-existing pathology in the Eustachian tube is

TABLE 1

INCIDENCE IN VARIOUS LOCALITIES, SHOWING GROUND ELEVATION AND AVERAGE RELATIVE HUMIDITY

Essavist or Reference	Location	Ground elevation above sea level (feet)	Average relative humidity	Incidence
Jones, C C [9]	Cincinnati, Ohio	533 ft	79 2%	High
Hotchkiss, W [22]	Miami, Fla	8	77 2	High
Hall, S S [20]	Clarksburg, W Va	977	76 7	High
Robison, J M [12]	Houston, Texas	138	76 0	High
Farrior, J B [23]	Tampa, Fla	24	75 5	High (Approx 6 per week)
Hantman, Irvin [11]	Keesler Field, Miss	9	74 7	High
Shahinian, L [24]	San Francisco, Cal	52	73 6	High
Eagle, Watt [19]	Durham, N C	406	72 0	High
Hoople, Gordon [1]	Syracuse, N Y	424	71 7	High (3-4% of total pts)
Lindsay, John [25]	Chicago, Ill	611	71 7	High
Author		621	69 5	High
McDougall, C [26]	Atlanta, Ga	977	69 2	High
Jordan, Ray [18]	Pittsburg, Pa	1248	68 5	High
Hickey, H L [27]	Denver, Colo	5292	52 7	Very low (Approx 6 per yr)
Bradley, J W [28]	Colorado Springs, Colo	6175	50 7	Low except in Spring months then 6-8/mo
Lamberson, W H [29]	Colorado Springs, Colo	6175	50 7	Low
Richardson, Geo [30]	Albuquerque, N M	5310	46 2	Very low Almost nil
Cruthirds, A L [31]	Phoenix, Ariz	1083	41 7	Very low (3 per 500 pts
Spearman, M P [32]	El Paso, Tex	3936	40 2	Extremely low Almost nil
Page, Donald [33]	Boulder, Colo	5400	35-40?	Low except in Winter

more likely to develop tubal obstruction and effusion in a moist climate at or near sea level than he would be in a high dry climate

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III — Age Incidence

Secretory otitis media may occur at any age but is most prevalent in young children, undoubtedly because they have more upper respiratory infections than any other age group, and because they are predisposed to tubal obstruction by enlarged adenoids or by hypertrophied lymphoid tissue in the fossa of Rosenmüller and furthermore by the smaller size of the pharyngeal opening of their Eustachian tubes as pointed out by Tremble[15] In the author's series, 120 of the total or almost one-third of the patients were children under 10 years of age The examination of many of these children was prompted by impaired hearing as discovered during school hearing surveys

For convenience of discussion, the author's series of 372 patients was divided into acute, subacute and chronic groups, depending upon the duration of the attack. The cases termed acute were of short duration with disappearance of the fluid within less than three weeks from the onset of symptoms. The subacute cases persisted from three to six weeks, and those termed chronic continued to have fluid in the middle ear for a period of six weeks to several years. One patient with malocclusion gave a history of having had symptoms for 10 years.

The various causes for each group are shown in Table 2 Many of these patients had more than one etiologic factor but only the predominant one was selected When active nasal allergy persisted, it was listed as the primary cause.

In the author's experience an upper respiratory infection was the exciting cause in almost two-thirds of the cases Allergy was considered to be the etiologic factor in 37 or approximately 10 per cent of the total number and 11 per cent of the chronic cases even though allergy was constantly kept in mind and searched for Nasal smears for eosinophiles were done almost routinely, and skin tests were done on many of those with questionable signs of allergy The author has not observed any appreciable increase during the ragweed hay fever season, which is very prevalent in his locality from late August to October

In children, hypertrophied adenoids or hypertrophied remnants of lymphoid tissue in the fossa of Rosenmuller were the chief predisposing factors The majority of these children developed bilateral effusion with each cold The greatest lymphoid hypertrophy occurred in the allergic children, as was emphasized by Jordan,[17] but the nonallergic children with large adenoids far outnumbered the allergic ones insofar as

TABLE 2
ETIOLOGY IN 372 CASES

ETIOLOGY	Acute	Subacute	Chronic	Total
Acute U R I	111	35	16	162
Sinusitis	24	16	19	59
Hypert adenoids (without apparent allergy)	7	20	37	64
Allergy	19	7	11	37
Previous Supp O M only cause	0	0	3	3
Aero-otitis	9	1	0	10
Contagious disease (measles, mumps)	2	0	0	2
Pregnancy (Endocrine)	1	0	0	1
Hodgkin's disease	0	0	1	1
Malocclusion	0	2	3	5
Malignancy of nasopharynx	0	0	2	2
Swimming	3	0	0	3
Unknown	7	9	7	23
	183	90	99	372

ould be determined It is admitted that there were very robably a number of patients whose obscure allergies were ot detected

Among adults, infections of the paranasal sinuses were ery prevalent. Most of these had involvement of one or more inuses on the homolateral side, but curiously enough a small number had involvement only on the ipsilateral side Malocclusion was the only etiologic factor in five, and lymphoepithelioma of the nasopharynx was the cause in two patients, one of these having bilateral effusion

Of interest was the unfortunate fact that the etiology could not be determined in 23 of the total Seven of these ran a chronic course.

PATHOLOGY

As mentioned above, there are two clinical types of this condition, serous and mucus, but many cases constitute a combination of the two

The serous fluid is thin, clear, light yellow and watery when first evacuated or aspirated from the tympanum, but becomes thicker and coagulates when exposed to air It is basically a transudate containing few inflammatory cells and usually has a low protein content, although the protein is quite variable.

The so-called mucus fluid is thicker and tenacious, sometimes turbid, usually very viscid, and much more difficult to remove. It contains many inflammatory cells, mostly polys and usually has a high protein content It is, therefore, an exudate Both are sterile by ordinary culture methods, as shown by Forschner[24] and others

CYTOLOGY

During the past year the author has almost routinely examined smears of the ear fluid stained with Hansel's stain and has observed that the number of inflammatory cells per high power field varies tremendously The thin serous fluid in cases without associated inflammatory disease contains only a few cells per H P F , whereas the more tenacious fluid may contain as many as 300/H P F or more, predominantly polys

I have been particularly interested in whether or not eosinophiles occur in the ear fluid of those patients whose secretory otitis is believed to be the result of allergy Koch[13] refers to Dohlman's report in 1941-1942, wherein the latter found eosinophiles in the secretion of secretory middle ear catarrhs, chronic otitis and mildly acute otitis, "in certain cases in a very large number," and states that Dohlman considered these to be of allergic origin He states further that Dohlman has given merely a general survey of his experiences, without any statistics with regard to percentage of eosinophiles found in the secretory otitis *medias* Hotchkiss[11] observed that "even in definitely allergic cases, the eosinophilic count is not dependable" The *only other published* report on the incidence of eosinophiles in secretory otitis media that the author could find was that by Jordan,[1] who stated that he found "occasional eosinophiles" in direct smears of the fluid, and 73 per cent of his chronic cases were *attributed* to allergy

I have looked painstakingly for eosinophiles in the ear fluid of at least 50 patients, including all those who had evidence of nasal allergy and those in whom the etiologic factor was assumed to be allergy, and have yet to find an eosinophilia in a single case, furthermore, I have seen only *one eosinophile* in the total of 50 slides examined! I do not mean to infer by this, however, that an absence of eosinophiles in the ear fluid precludes an etiologic diagnosis of allergy as the cause of tubal obstruction The allergic reaction may be limited to allergic swelling in the pharyngeal end of the tube, thereby creating a negative pressure, without producing a true allergic edema and eosinophilia in the tympanum

CHEMISTRY OF EAR FLUID

Lowy[14] states that Schlander and Goebel demonstrated by means of protein determination on the middle ear exudate that the fluid is due partially to an exudation and partially to a transudation, and that the majority of the secretory catarrhs can have only an inflammatory origin, but their manuscript is not available for review There is disagreement among other authors concerning which type of fluid has the highest protein content, the thin serous type or the thick mucus exudate Robison[13] found a high total protein content in the exudate containing many polymorphonuclear leucocytes and a low protein content in the thin transudative fluid containing a few polys Hoople,[1] on the other hand, states that the thin serous fluid has a high protein, and the thick mucus exudate a low protein content

According to Cantarrow and Trumper,[14] the protein content of transudates and exudates in various parts of the body can vary tremendously because of variations in the intensity of the inflammatory process and variations in capillary permeability They state that in the case of exudates resulting from inflammatory processes of lesser intensity, such as pneumonic pleurisy and tuberculous peritonitis, the total protein concentration usually ranges from 0 1 to 5 gm per 100 cc. The protein content of noninflammatory edema fluids or transudates is said to be relatively low (0 1 to 1 gm per 100 cc.), since their pathogenesis is usually independent of alterations in capillary permeability They state further, however, that if the effusion has existed for some time, water may be reabsorbed more rapidly than solids, resulting in a slowly increasing concentration of protein which may eventually approach that of true exudates

I have through curiosity done some protein determinations along with cytologic smears in a small number of cases to see whether there is any constant correlation between the total protein and the number of inflammatory cells in the fluid, which is what one would normally expect.

The fluid was collected by aspiration through the drum with a short bevelled 20 or 22 gauge needle attached to a tuberculin syringe. The volume of fluid obtained by this method varied from 0 1 to 0 4 cc., but usually only 0 1 to 0.2 cc. could be collected The fluid was diluted to 2 cc. with normal saline and protein determination done in the usual manner as for serum protein

The results, along with the cell count, gross description of the fluid, the etiology and chronicity are shown in Table 3

TABLE 3

Patient	Gross appearance of fluid	Protein content	Cell count	Etiology	Chronicity before trt	Result
#1 M P P	Thin serous	1 25 Gms/ 100 cc	Not done	Cold	1 week	Cleared in 1 week
#2 J P K	Thin serous	1 45 Gms	22/HPF most polys	?	1 month	Fluid persists after 3½ mos
#3 J S	Thin watery light yellow serous	3 4 Gms	18/HPF	Nasal allergy	1 day	Cleared in 1 week
#4 O H R	Thin watery light yellow serous	3 9 Gms	No inflam cells Few rbc/HPF	Partial cicatricial stenosis of E T ? Nasal smear neg	4 months this attack Recurrent since 1920	No follow-up
#5 H L M	Med consistency serous	4 4 Gms	23/HPF Predom lymphocytes plus 27rbc/HPF	Supp max sinusitis, bilat	2 weeks	Cleared in 3 weeks
#6 J L H	Thick mucus glue-like	5 0 Gms	225/HPF Mostly polys	Cold plus narrowed eust orifice. Nasal smear neg	3 weeks Hist of similar attack 10 yrs before	Fluid persists after 8 mos Cleared for periods of 6 wks and 8 wks Recurred with colds
#7 C S	Thin serous	5 25 Gms	No inflam cells Few epithelial cells	Hodgkin's disease Lymphatic blockage?	2 months	Cleared 1 mo after external irradiation
#8 G C	Medium consistency serous	6 2 Gms	26/HPF plus large clumps	Cold Nasal smear neg	6 months	No recurrence
#9 A E J	Medium consistency serous	7 2 Gms	2/HPF plus 10-15 rbc/HPF	Cold Nasal smears neg	3 months	No recurrence

As shown by a study of the above table, there was no constant parallel between the total protein content and the cell count, although the thin, watery, serous fluid tended to have a lower protein and a lower cell count than the more tenacious fluid. If only two of these were selected for comparison, however, *e g*, No 6, J L. H, who had a thick mucus type of fluid with 225 polys/H P F, definitely an exudate, and No 7, C S, who had a thin serous type of fluid containing no inflammatory cells and without question a transudate, one might come to the conclusion that the protein content of the mucus type is lower than that of the serous type, which is probably erroneous in most cases

The percentage of error due to the dilution factor is estimated to be only approximately 10 per cent. The protein content may be affected very slightly by the presence of a few erythrocytes, but none of the fluid was grossly blood tinged, and I know of no less traumatic method of collecting the fluid than with a needle and syringe The thick mucus fluid is very difficult to collect by any method.

The only conclusion that can be drawn from this study is that a larger number of determinations should be carried out to see whether any correlation can be shown between the gross appearance of the fluid, cell count, protein content, duration of the disease, etc. The author intends to continue this investigation according to this plan

SYMPTOMS

Adults with an accumulation of fluid in the middle ear usually describe their sensations realistically Most complain of a 'stopped up" or "full feeling" in the ear Others state quite accurately that they have water in the ear and at times they can feel fluid moving about or bubbling upon sniffing or forcefully blowing the nose Many will say that the ear feels numb or dead' and this sensation of numbness is imparted also to the skin around the auricle, noticeable upon rubbing the ear or combing the hair on the affected side. These patients usually have a full tympanum and mastoid cavity

Autophony is commonly described as "talking with the head in a barrel" A diagnostic symptom, if the middle ear is only partially filled, is the temporary improvement in hearing upon tilting the head toward the affected side or upon lying down, thus permitting the fluid to drain away from the round window, or probably because the pressure of the fluid upon the round window is relieved thereby

They may give a history of having been treated by other otolaryngologists by inflation with improvement in hearing for a short time

In the case of young children, the only symptom is usually an impairment of hearing which has been noticed by the parents, the school teacher, or after routine school audiograms

DIAGNOSIS

The diagnosis can usually be suspected from the history Inspection usually reveals the characteristic amber or yellow color imparted to the translucent drum, which is not inflamed and may or may not be retracted If the drum is opaque, this amber color usually cannot be detected In long standing cases the drum occasionally has a bluish color, probably due to the congested mucosa on the promontory Hoople[1] has emphasized the chalk white appearance of the malleus handle and short process which gives the impression that the drum is retracted when it may not be at all

If the tympanum is not filled with fluid, one can often see a fluid line or bubbles through the drum, and when these signs are present the diagnosis is readily apparent, however, a full tympanum is encountered many times more frequently than the drum with a meniscus The pneumatic otoscope or Politzerization may be helpful in demonstrating bubbles or a fluid line

The hearing loss, conductive in type, varies with the amount of fluid present The audiometric curve, although not characteristic, is most often flat unless there is a pre-existing inner ear lesion Lowy[37] observed that in approximately one-third of the cases, the hearing loss was severe, with considerable loss in the range of the higher tones. He does not attribute this to damage of the inner ear, but to increased tension and impaired mobility of the fenestra rotunda, as the signs of inner ear impairment largely disappear following evacuation of the fluid

Wever[48] recently commented upon the effect of fixation of the ossicular chain by fluid, saying, 'When it comes in contact with the drum membrane and ossicles this substance (fluid and semifluid substance) dampens and loads their movements, and when finally it fills the cavity it adds stiffness as well The result is an impairment of sensitivity that in the early stage affects the high tones the most seriously, and then in the severe stages includes all tones."

The next step usually recommended, if one is not certain of the presence of fluid, is the diagnostic inflation using a catheter and diagnostic tube. Many auscultatory sounds have been described in detail by Hoople,[1] Hotchkiss[21] and others, and need not be repeated here. As one becomes more accustomed to recognizing the drum with fluid behind it, the necessity for diagnostic inflation diminishes, unless, of course, the drum is opaque. The author is in agreement with Eagle[14] that it is preferable to avoid using the Eustachian catheter if at all possible because of its traumatic effect upon the pharyngeal orifice of the tube and the risk of prolonging the disease

If one suspects fluid in the tympanum, a diagnostic paracentesis may as well be done initially if the symptoms justify it the indications being the same of course, as though one had no doubt about fluid being present. This can be done without anesthesia with a short bevelled needle attached to a tuberculin syringe or in the usual manner with a knife. If fluid is encountered upon suction or Politzerization, the opening must be enlarged as for treatment purposes, particularly if the fluid is of the thick mucus type One can usually foretell the nature of the fluid by the appearance of the drum When the fluid is serous, the drum is more apt to be thin and transparent, with an amber or yellow color When thick mucus is present the drum has a more reddish hue with a dispersed light reflex, i e, more of a sheen on the surface, and it is less transparent

Having established the presence of an effusion in the ear, one must then search carefully for its cause If the etiology is not apparent in the nose, sinuses, mouth, nasopharynx or neck, one should enlist the aid of an internist who is in a better position to discover possible systemic disorders

Cytologic study of smears of the ear fluid will often give a clue as to whether the etiology is inflammatory or noninflammatory by the number of polymorphonuclear cells present

PROGNOSIS

With regard to prognosis, most observers agree that the longer the condition has persisted prior to treatment, the less favorable the chances for a complete cure

Ears containing a small amount of fluid respond to treatment more promptly than those which are full The mucus type of secretory otitis media is more often resistant to treatment than the serous type, probably because there is a low-grade inflammation of the mucous membrane of the Eustachian tube and tympanum, and these changes become irreversible after a variable period of time Those patients with a blue discoloration of the drum are usually more resistant to treatment Patients in whom one is unable to find any definite etiologic factor have much less chance of getting well, although they may do so spontaneously if and when the unknown pathology subsides

Why some ears develop adhesive processes after a relatively short time and others continue to harbor fluid for many years without forming adhesions is not known We do know that the fluid coagulates readily when exposed to air, and it may be that when fluid remains in the tympanum after the Eustachian tube becomes patent, it then coagulates and tends to form adhesions We should, therefore, continue treatment as long as any fluid remains in the middle ear

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In the vast majority of cases, the hearing returns to normal after the fluid is evacuated, regardless of the number of myringotomies unless there are adhesive processes or pre existing inner ear pathology

TREATMENT

There are two objectives in the treatment of otitis media with effusion, namely, to rid the middle ear of fluid and to prevent its recurrence by treating the associated etiologic condition if this can be determined The preservation of normal hearing is the most important objective, but this will be attained if the ear is kept free of fluid and adhesive processes are thereby prevented

The first objective is much more easily accomplished than the second, and unless we are able to make a correct etiologic diagnosis we are almost sure to fail except in the acute cases of recent onset, which have a fair chance of clearing up spontaneously

The treatment varies somewhat with the duration of symptoms, the quantity and type of fluid present, and the cause of the tubal obstruction

Cases with symptoms of short duration, such as an aero-otitis media with effusion, or those with an associated acute inflammatory condition in the nose or throat will often subside after proper attention to the acute nasopharyngitis or sinusitis, perhaps combined with subsequent Politzerization after the nose and nasopharynx are free of pus.

In the absence of a coexisting acute inflammatory condition n the nose or throat, if there is only a small amount of fluid present and the hearing is not markedly impaired, one is usually content with trying Politzerization alone for a week or so, but at the same time searching for and treating the cause of the tubal obstruction

If the tympanum is full of fluid as is the case more often than not, or if the history indicates that the fluid has been present for a week or longer, one may as well proceed with myringotomy at the first visit, except in children with nasal allergy or infected hypertrophied adenoids These children's ears will clear up only when the allergy is controlled or the obstructing lymphoid tissue removed by one method or another

The myringotomy incision is usually made along the inferior half of the drum, and as long as possible, with the hope that it will remain open for a week or so, however, it usually heals within 48 hours, which is much too soon The myringotomy is then repeated as often as the fluid accumulates

Having opened the drum, we have a choice of several methods of forcing the fluid from the middle ear, namely, Politzerization, catheter inflation, suction applied to the external canal with Siegel's otoscope, spot suction, or a combination of these The author has learned by experience, as did Politzer,[2] Eagle[18] Hotchkiss[21] and others, that catheterization inflicts too much trauma on the orifice of the Eustachian tube and probably prolongs many cases that might have cleared up promptly had the catheter not been used I have seen several patients with symptoms of brief duration and with little or no visible swelling about the orifice of the tube on first examination, who, after several catheterizations, were observed to have definite edema of the orifice and then ran a protracted course Since this observation was made, I have used Politzerization and suction exclusively to remove fluid after myringotomy Catheterization for auscultation is sometimes necessary to establish a diagnosis of fluid in the ear, in which case the beak of the catheter should be placed gently under direct vision with a nasopharyngoscope

If the fluid is of the thick mucus type, the incision in the drum is made longer and spot suction is applied simultaneously with Politzerization to prevent the mucus mass from being drawn back into the tympanum as soon as the positive pressure has ceased and the intratympanic negative pressure again prevails The placing of a pledget of cotton against the myringotomy opening to absorb the serous and seromucoid fluid as it is forced out also aids in evacuating the fluid more effectively After one has emptied the tympanic cavity as well as is deemed possible at one sitting, a pledget of cotton left in place against the drum will usually absorb additional serous fluid as it subsequently drains from the mastoid cells into the tympanum

Having evacuated the fluid from the middle ear, one must not forget to treat the primary condition responsible for its presence Local conditions in the nose and nasopharynx which might act as influences toward recurrence should be corrected

Jordan[17] employs a trial period on antihistaminics if the etiology is not established and when allergy is suspected

Jones[9] reported good results with the use of an autogenous vaccine made from culture of the nasopharynx in a few chronic recurrent cases The author has had no personal experience with vaccines in the treatment of this disease

The use of a permanent perforation in the drum has been advocated by some and condemned by others. Hotchkiss[11] believes that it is justified in selected cases which do not subside in spite of corrected causative disease *especially in older individuals in whom a perforated drum is of little concern* (He uses a corneal trephine on a long handle to make the permanent opening)

Mastoidectomy has been performed as a last resort by several authors in chronic resistant cases Although this writer has performed a mastoidectomy on only one patient with secretory otitis media he has formulated the following opinion regarding the type of case most suitable for operation *1* a chronic secretory otitis media resistant to all other forms of treatment, *2* with corrected or with no apparent associated nasopharyngeal or sinus disease, *3* with an inflatable Eustachian tube, *4* responding temporarily to myringotomy and inflation, indicating that the hearing loss is not irreversible, and *5* with a fairly well pneumatized mastoid. Conversely, there would be little or nothing to be gained by operating upon a sclerotic mastoid, upon a patient whose Eustachian tube is noninflatable, or upon a patient whose hearing does not return to a useful level at least temporarily after evacuating the fluid

RESULTS OF TREATMENT

Considering the series as a whole, the results of treatment were fairly satisfactory As mentioned earlier in this paper, there were 183 patients whose symptoms lasted from a few days to three weeks, 90 patients who were well after three to six weeks, and 99 whose disease persisted longer than six weeks The total of 372 patients had a total of 439 separate attacks Forty-six patients had from one to 16 recurrences

Although a total of 449 myringotomies were done, 104 patients in the acute and subacute groups became rid of the fluid without myringotomy This number does not include 28 children in all categories whose ears returned to normal without myringotomy following adenotonsillectomy Another 115 patients in the acute and subacute groups returned to normal after only one myringotomy, 31 2 per cent of the total had bilateral involvement

Considering only the group of 99 chronic cases, the results were more disappointing Of these, 52 were eventually declared well and 18 improved Another 18 were not improved after prolonged treatment, and there was insufficient follow-up observation in 11 patients Two of those not improved had lymphoepithelioma of the nasopharynx

The results in 45 patients in the chronic group treated by various methods for hypertrophied lymphoid tissue about the Eustachian orifice are shown in Table 4

The author discontinued using the radium applicator several years ago, but it seems that the immediate results in this small group were essentially the same as with external irradiation Several of those who did not respond to irradiation were later found to have an allergy as the primary etiology

Of the 11 patients with chronic secretory otitis of allergic etiology, four became free of fluid while receiving injections of dust and mold extract, three improved on allergic management before they discontinued treatment, and two showed no improvement with antihistaminics or specific therapy The remaining two patients in this group were of interest in that they may well be classified as belonging in the category of intrinsic allergy with perhaps an autonomic dysfunction and arteriolar spasm as the underlying pathology In any case, they both responded to vasodilator drugs after being resistant to all other forms of treatment. Their case histories are summarized as follows

TABLE 4

RESULTS OF TREATING HYPERTROPHIED LYMPHOID TISSUE IN NASOPHARYNX, IN 45 CHRONIC CASES

Method of Treatment	Total no treated	Number cured	Not cured
Radium applicator	15	8	7
External irradiation	9	5	4
Adeno tonsillectomy	22	19	3
	46*	32	14

One of those not improved after adenotonsillectomy later cleared up after external irradiation

Case 1 Mrs L. W., age 51. Complained of roaring and fullness in left ear vertigo and throbbing pains in left temporal and parietal regions daily for two weeks following a "cold." The *left* drum was retracted and amber in color Rinne negative. Serous fluid was evacuated on myringotomy and inflation. The nose sinuses nasopharynx and Eustachian orifice appeared *essentially* normal The fluid recurred after a few days when myringotomy and inflation was repeated and an antihistaminic prescribed. She continued to have recurrences of fluid and left-sided headache and during the ensuing six weeks five myringotomies were done An X ray of the mastoid revealed 'moderate increase in density of the air cells of the left mastoid with some haziness of the cell walls No bone destruction Findings are consistent with an acute or subacute mastoiditis left." The X ray changes were of course due to the presence of serous fluid in the mastoid air cells Nasal smears were negative for eosinophiles. Two months after the initial visit she still had fluid in the ear and almost daily attacks of left sided headache which seemed to be similar to histamine cephalgia She was given daily subcutaneous injections of 1 100 000 histamine and after four days the headache did not recur The fluid in the left ear was blown out once more at this time. Histamine injections were continued and subsequent examinations over a period of two months showed no recurrence of effusion in the middle ear Hearing returned to 15/15 for whispered voice

Case 2 Mrs J F K, age 49 c c Fullness in both ears and impaired hearing for 10 days Two inflations elsewhere with very temporary improvement History of occasional hay fever in the past but no associated symptoms at time of onset of ear trouble Both drums retracted with serous fluid in tympanic cavities Eustachian orifices edematous Nasal mucosa slightly paler than normal, sinuses and nasopharynx negative Nasal smear and ear fluid negative for eosinophiles W B C normal. Pyribenzamine was prescribed empirically On Politzerization air traversed the right Eustachian tube but not the left During the following two and one-half months the drums were incised many times and fluid aspirated, but each time the ears became full again within a few days The Eustachian orifices remained slightly edematous Further investigations had been carried out including skin tests which were all negative The B M R was minus 17 and the blood cholesterol was very slightly elevated On the strength of this thyroid extract was prescribed by the internist without improvement A food allergy was then suspected but there was no improvement on a nonallergic diet. A culture of the nasopharynx revealed hemolytic streptococci and an autogenous vaccine was ordered, but never used While the vaccine was being prepared several bits of tissue were removed from the nasopharynx for biopsy that were negative for malignancy Then one day the patient presented herself with an edematous swelling of the left upper eyelid This suggested the possibility of arteriolar spasm and capillary dilatation as the cause of the edema She was started on niacin 100 mgm t i d before meals Both drums were opened with evacuation of a large quantity of serous fluid There has been no recurrence of fluid for a period of six weeks

Both patients had associated signs of vasomotor or autonomic dysfunction — a vascular headache on the homolateral side in Case 1, and an edema of the eyelid and a history of extreme sensitivity to temperature changes in Case 2 The response to the histamine desensitization and to the niacin may have been coincidental, but the evidence seems more to the contrary A longer period of observation is needed before any definite conclusions can be drawn

SUMMARY AND CONCLUSIONS

1 The available literature pertaining to the subject of secretory otitis media has been reviewed and the author's series of 372 cases analyzed with regard to etiology, pathology and treatment

2 The apparent increasing frequency of this disease is largely due to increased vigilance on the part of otolaryngologists during the past decade, and to a lesser extent due to the influence of widespread use of antibiotics The rôle of virus infections (in the etiology of this disease) has not been satisfactorily determined

3 A scattered survey of the incidence in various parts of the country suggests that secretory otitis media occurs much more frequently in areas of low altitude with a high relative humidity

4 Upper respiratory infections are the chief predisposing causes in adults as well as in children Hypertrophied lymphoid tissue in the nasopharynx plays an important rôle in children Allergy accounted for 10 per cent of the entire series and 11 per cent of the chronic cases

5 Differences in the thickness of the tympanic mucosa and variations in capillary permeability may be deciding factors as to which ears with an obstructed Eustachian tube develop effusion and which ears do not. Autonomic dysfunction can adversely affect capillary permeability

6 Normal variations in the size of the isthmus of the Eustachian tube may explain in part why some ears become chronic and others do not under similar circumstances

7 Some middle ears continue to harbor fluid after the Eustachian tube has become patent. The secretion in these ears is usually of the mucus type, the result of continued low-grade inflammation of the mucosa which probably has undergone metaplasia.

8 Protein determinations on the ear fluid of a limited number of the author's patients does not support the view that the serous fluid has a high protein content or that the mucus fluid has a low protein content Wide variations were found to exist in similar types of fluid Comparative studies of the gross appearance of the fluid the cell count, and protein content showed that thin serous fluid usually had a low cell count and low total protein however no definite pattern could be established Further comparative study of a larger number of such determinations is indicated

9 Eosinophiles rarely occur in the fluid of secretory otitis media, even when the tubal obstruction is the result of allergy An eosinophilia was not observed in any of the more than 50 slides examined

10 The Eustachian catheter should be used as gently and as sparingly as possible in the diagnosis and treatment of this disease as the trauma inflicted on the pharyngeal orifice of the tube undoubtedly prolongs the course of the condition

11 Mastoidectomy should probably be done more often on the chronic resistant cases to preserve hearing The author has expressed his opinion as to the type of case best suited for mastoidectomy

12 The vasodilator drugs may prove useful in the treatment of this condition if there are associated signs of autonomic disorder Two cases are cited in which they were seemingly of therapeutic value

13 Secretory otitis media remains one of the greatest problems in otolaryngology today, but this fact is still not appreciated by many

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NASAL SINUS DRAINAGE
Factors Which Influence Bernoulli Action *

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INTRODUCTION

The author has written three previous articles on Bernoulli action in the nose in which he has attempted to show various mechanisms whereby blowing of the nose produces suction at the sinus ostia [1-3] The present paper is a discussion of various factors which influence Bernoulli action

We should hold in mind throughout this discussion that we are not considering air currents in normal or even in forced respiration, nor are we concerned with the atrophic nose or even with a normal nose with wide breathing space At the moment, we have no interest in what pattern a puff of smoke will make in the nose of a cadaver

Our remarks at present are strictly limited to *forceful expirations* through a *congested nose* There is another fact which we should keep in mind The constriction of the air space of the nose to which we shall refer is caused by swelling of the turbinates The turbinates are composed of erectile tissue and erectile tissue in the nose is just as unpredictable and irresponsible as erectile tissue found elsewhere in the body This explains why the Bernoulli effect is so variable when we blow our noses Thus, when recovering from a head cold, one may blow his nose without result and a few seconds later blow it with very satisfying productivity

I — Conformation of Residual Air Space in Nose

If the nose is congested to such an extent that there is only a small air passage through it, we are interested only in the

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shape of that residual air passage *If this remaining* air passage is comparatively straight and is of an equal caliber or bore throughout its length, we can expect no Bernoulli effect. On the other hand, *if this air passage* is constricted anywhere along its entire length, there *will be increased* velocity of air at the constriction and diminished pressure in that area when one blows his nose. If a nasal sinus ostium is located in the area of constriction of this residual air passage, it is subjected to Bernoulli action when one blows his nose

It is difficult to conceive of a conformation of this residual air space which can produce suction simultaneously at all ostia which open into it. It is equally difficult to imagine a constricted air space which does not produce suction at at least one ostium along the line.

II — Residual Air Space in Sinuses

Throughout this paper I have intentionally avoided frequent use of the term "suction" as applied to Bernoulli action This was done in an effort to have us keep in mind that the only force which can be employed in forcing mucus through the ostia into the air stream is the pressure of the air in the *sinuses. Regardless of the actual air capacity of a given* sinus, this air capacity may be encroached upon by swelling of the soft tissues within the sinus and by the accumulation *of mucus or pus within the sinus.* So *in a nasal sinus, the* only *effective* air capacity is the residual air space.

Let us assume as we did above, that the ostium opens into a constricted portion of the residual nasal air passage into an area of diminished pressure. On blowing the nose, we start off with *approximately* atmospheric pressure of the air in the sinus, which *pressure rapidly diminishes as* the mucus is forced through the ostium This motion of mucus continues until the pressure within the sinus is no greater than the pressure in the nasal air passages or until the mucus bubble bursts. On the termination of the blow, atmospheric pressure re-establishes in the sinus. When mucus is again condensed at the sinus ostium by ciliary action, we have proper conditions for a repetition of the process.

III — Patency of Sinus Ostia

It stands to reason that, if a sinus ostium is solidly blocked by soft tissue swelling, it is incapable of transmitting any Bernoulli effect to its sinus This is true whether the blockage is in the ostium proper or whether the obstruction is caused by overlying turbinate edema It is possible, however, for soft tissue to overlie the ostium in such a manner as to block its normal opening into the air space but allow it to communicate with the residual air passage of the nose at a more proximal or distal position In such a case, this fissure or slit serves as an adventitious ostium and, if it is located in an area of air space constriction, it will act like a true ostium as a pathway for Bernoulli action

If an ostium is blocked with mucus, it does not preclude Bernoulli action As we shall discuss later, such a condition is ideal for productive Bernoulli effect

IV — Viscosity of Mucus

The mucus can be so thick that there is difficulty in forcing it through the ostium On the other hand, it can be so watery that the cilia cannot condense it at the sinus openings

In the first case, more force than usual is required to force the mucus into the air passage In the latter instance, Bernoulli action is ineffective for the simple reason that it cannot grasp the mucus to remove it

V — The Force Which One Employs on Blowing His Nose

Some years ago, when I was afraid that some Bernoulli critic would object to my drawn glass tubes which I used to represent constrictions in the nasal air passages, I resorted to a straight glass tube with a tap in the middle to represent a sinus ostium

Into the straight tube I inserted two rubber dam tubings filled with water The ends of this tubing were pulled together on the outside of the glass tube and tied in position on either side of the tap The rubber tubing inside the glass tube, being distended with water, encroached on the air space and fairly represented a nasal constriction formed by apposition of turgescent turbinates

I attached a water manometer to the tap and blew through the glass tube. I found that when I blew lightly there was a slight amount of suction, but when I blew forcefully, the manometer registered pressure This puzzled me for a long time until it was finally explained to me by one of my engineer friends who noted that when I blew with force through the tube the soft rubber and water constriction moved distally

Thus, it is conceivable that on blowing the nose one may get suction at a given sinus ostium when he blows lightly and get no suction at all when he blows harder because of the fact that he distorts the congested turbinates and moves the area of constriction anteriorly

The opposite effect of varying air pressure on blowing the nose is illustrated by the following experiment

Push a close fitting rubber tube into a straight glass tube which has one middle tap Adjust the rubber tube so that it comes up close to the tap Blow gently through the rubber tube A manometer attached to the tap shows suction

Continuing to blow lightly through the rubber tube, withdraw it gradually until no suction registers on the manometer Now, holding the tube in the same position, blow forcefully Again the manometer registers suction.

The change in Bernoulli effect due to the force exerted probably explains the fact that an accomplished nose blower has a repertoire which varies from a light zephyr to a trumpeting blast.

If the constriction is distal to the ostium reversal of the air flow by sniffing may produce effective Bernoulli action

VI — Condensation of Mucus at Sinus Ostium by Ciliary Action

We will take as an example one of the maxillary antra which has accumulated a considerable amount of mucopus on its floor We will assume that its ostium opens into the middle meatus at the most constricted portion of the residual air space of a congested nose The ostium is patent and mucus on the floor of the antrum is of the ideal viscosity for forcing through the ostium.

We might think, with the above mentioned favorable factors, that all conditions will have been met for a productive nose blow, but there has been no condensation of mucus at the sinus ostium, and the blowing of the nose will result only in a momentary rarefaction of the air in the sinus and will be entirely unproductive

How can the mucus be brought to the ostium? I know of only four mechanisms by which this can be accomplished *1* we might tilt the head so that mucus reaches the ostium by gravity, *2* the antral mucous membrane may swell and bring the mucus up to the level of the ostium, *3* we may have increased secretion which brings the level of mucus to the ostium, *4* the cilia of the antral lining may walk the mucus along the floor and walls to the sinus opening Certainly there is no disagreement in the opinion that ciliary action is the most important mechanism for transporting mucus and condensing it at the sinus ostium This condensation is an absolute requisite for productive Bernoulli action

What I am about to say is purely conjectural, but I believe that, when the cilia have condensed the mucus at the ostium and the mucus has formed an air seal in the ostium, as the cilia further attempt to push it into the nasal air passage there is produced a slight diminution of air pressure in the sinus which serves as a stimulus for a sneeze or a nose blow

If the ostium happens to be in a pressure area of the residual air space, air will bubble through the mucus into the sinus and re-establish equalization of pressure If, on the other hand, the ostium is located in an area of diminished pressure, the mucus is forced out into the nasal air passage by the air in the sinus until the bubble of mucus breaks Thus, on the completion of the blow, atmospheric pressure is re-established in the sinus So, no matter whether the sinus ostia are located in areas of pressure or diminished pressure, nose blowing or sneezing tends to produce equalization of pressure in the sinuses

CONCLUSIONS

In this paper we have discussed the various factors which influence Bernoulli action in drainage of the accessory sinuses of the nose. We have seen that all of these factors are variable and this very variability explains why the productiveness of a given nose blow is unpredictable

All of the favorable factors necessary for effective Bernoulli action are likely to be present in a moderately congested nose, and it is only on occasions of nasal and sinus congestion that such action is desirable. *There is no necessity* for draining a sinus which is empty

Of all the factors which influence Bernoulli action, only one can be readily controlled voluntarily that is the timing and force which one employs in blowing his nose.

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Manufacturer Nichols & Clark, Hathorne Mass.

Vacolite Models J and J 2

Manufacturer Vacolite Co. 3003 N Henderson St., Dallas 6 Tex.

Western Electric Models 65 and 66

Manufacturer Audivox, Inc., successor to Western Electric Hearing Aid Division, 259 W 14th St. New York 11 N Y

Zenith Model 75, Zenith Miniature 75, Zenith Model Royal, Zenith Model Super Royal

Manufacturer Zenith Radio Corp. 6001 Dickens Ave. Chicago Ill.

All of the accepted hearing devices employ vacuum tubes

Accepted Hearing Aids more than five years old have been omitted from this list for brevity

TABLE HEARING AIDS

Aurex (Semi-Portable)

Manufacturer Aurex Corp 1117 N Franklin St. Chicago 10 Ill.

Precision Table Hearing Aid

Manufacturer Precision Hearing Aids 5157 W Grand Ave Chicago 39 Ill.

Sonotone Professional Table Set Model 50

Manufacturer Sonotone Corp Elmsford N Y

All of the Accepted hearing devices employ vacuum tubes.

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THE
LARYNGOSCOPE.

VOL. LXII FEBRUARY, 1952 NO. 2

PLASTIC AND RECONSTRUCTIVE SURGERY *

JAMES T. CHAMNESS, M.D., and JAMES BARRETT BROWN, M.D.
St. Louis, Mo.

With the rather dramatic turn in world events in the past year, involving the possibility of a third world war and its almost inevitable atomic bombing, there has been a stimulated interest in medical preparation for a stupendous holocaust and in the treatment of the resulting thermal and irradiation casualties.

Both Clarkson[1] and Evans call attention to the enormity of the problem and the necessity of prompt organization of medical supplies and personnel to effectively deal with it.

The overall program must include *1* evacuation of all but minor injuries, *2* accommodation by mobile units and burn centers *3* provision for supply from "medical dumps" plus the standardization and simplification of treatment, and *4* adequate personnel which requires the training of more civilians.

Emergency management of the cases include relief of pain, dressing, prevention and treatment of shock, salt and water requirements, and antibiotics. Pain can be handled by small doses of morphine. Simplification of dressings can be achieved by incorporating fine mesh gauze, thick cellucotton pads and tough outer layers of cotton into one large roll. The exposure

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*From the Department of Surgery, Washington University School of Medicine and Barnes Hospital, St. Louis, Mo.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication, Aug 1, 1951.

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THE
LARYNGOSCOPE.

L. LXII OCTOBER, 1952 No 10

THE 1952 HERBERT STANLEY BIRKETT LECTURE, A CRITIQUE OF PRESENT DAY METHODS OF HEARING TESTING'*

D E S WISHART, M D,
Toronto Canada

We are assembled to honor the memory of a name great in he medical annals of McGill University, Montreal and Canada. To those responsible, I express my sincere thanks for inviting me to deliver the 1952 Herbert Stanley Birkett Lecture.

Those of you who have read the admirable obituary, penned by your own Dr W J McNally and published in the *Annals of Otology, Rhinology and Laryngology* in 1942, will be astonished at the multitude of Dr Birkett's activities and accomplishments He was a truly amazing man and his success, phenomenal Unquestionably, he is one of whom you must always be proud

I had the pleasure of being in his company many times, for he was a close friend of my father They were at McGill at the same time, in medicine, and in the same fraternity They were alike in their hatred of what their consciences knew to be wrong Dr Birkett jealously guarded and upheld the integrity of otolaryngology To me he was a shining example of what a courteous gentleman should be I remember him most for the way he seemed to consider charitably that some of my faults were prompted by better motives

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Read at McGill University Montreal Canada, April 28 1952.

Editor's Note This ms. received in Laryngoscope Office and accepted for publication, June 16 195

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Read at McGill University Montreal Canada, April 25 1952.

Editor's Note This ms. received in Laryngoscope Office and accepted for publication, June 15 195

He was a very great Canadian doctor and I deeply appreciate the honor of delivering the lecture by which his name is perpetuated

* * * *

Ever since the teaching of medicine commenced in Montreal the name of McGill University has been world famous Some of the hospitals in this city are now about to tear down the buildings which have served them so well and are engaged in planning that the new structures shall be worthy of the great traditions of the past

One of the problems which you as otolaryngologists must settle for good or ill is how you shall plan for proper attention to hard-of-hearing adults and children

Hearing Testing Unsettled

The testing of hearing is in a muddled state

The formerly accepted tests of hearing have been proved so inaccurate that they have been abandoned almost everywhere In their place came the pure-tone audiometer for a time, but it has now become apparent that it is impossible from the study of an audiogram to determine how well a patient hears speech The result has been the re-establishment of measured speech-hearing-testing

In the enthusiasm for this, certain great hospitals have set up establishments for testing hearing which are costly and complicated The claim is made that the many elaborate tests thus made possible provide information of value There is, however, another side to the picture

In certain of these hospitals only a very few technicians — in some only one — can or are allowed to run the audiometers and use the soundproof room, the examinations are lengthy and may take five hours or more to complete, and they are fatiguing to the patient The reports issued are couched in such terms that few if any of the attending staff can understand them, it is rarely claimed that they can be used for comparison with results obtained on other occasions, and to method, which has been reintroduced recently, is simple but remains to be proved adequate for deep burns. A safe and sure plasma substitute is still much needed for use in large amounts and for large numbers of cases. Stock piles of penicillin should be readily available.

Unless proper planning is done and the medical authorities perform their proper function without wasting expert manpower, chaos will result.

BURNS

Treatment.—McDowell re-emphasizes that any deep burn if large or in a kinetic area should always be grafted as soon as a suitable granulating bed appears without waiting for the formation of a crippling scar. Primary treatment to the local areas should consist of fine mesh grease gauze and dry pressure dressings. The first dressing may be left five to seven days and thereafter frequent dressings for mechanical cleansing are necessary in preparation for grafting. Severe scar contractures if allowed to develop without being excised and grafted frequently eventuate in the development of squamous cell carcinoma. The experience of Marcks and Trevaskis has been similar. A more frequent and earlier use of homografts in extensively burned patients is urged by Sanders and Moore.

Recent burns of the hand are usually treated by Ross with immediate excision of the totally destroyed skin and grafting. Pain sensitivity was found to be the best aid to clinical observations in the differentiation of totally destroyed skin. Cases grafted later consisted of those in shock due to the extent of the burns or those in which the depth of burns could not be determined when first seen. On the other hand, Miller and Posch still recommend the orthodox treatment of burned hands.

Colebrook considers infection the all important problem of burns and advocates dressing burns in an atmosphere almost microbe-free. This would require twice filtering and warming crown all — some of the government boards to whom these elaborate reports are made for purposes of determining pensions, etc., completely disregard these audiological findings and base their decisions on unmonitored conversational voice

In what follows I hope to convince you that certain prevalent fashions in the testing of hearing are wrong and to indicate certain other things which are essental

Purposes of Hearing Tests

Hearing tests are performed for nonmedical as well as for medical reasons Examples of the former are — the determination of the suitability of employees for certain jobs, the effect of workshop noise on the employees, the screening out of the school children who should be referred to a doctor, etc. These can be performed by technicians or by the specially trained technician — the audiologist

On the other hand, hearing tests for diagnosis, prognosis and evaluation of treatment should be performed by the otologist. For he serves patients who wish to know why their hearing defect exists, what the future holds for them and what can be done to alleviate the impairment. The main essential of a hearing test is measurement.

Otologist Squeezed Out by Audiologist

Even as short a time as 15 years ago there were few ear, nose and throat clinics where there was any provision whatever for the testing of hearing, the few hospitals where an attempt was made to provide proper facilities were distinctive because of such provision. Now, however, great changes have occurred, and there are many cities where one or more hospitals provide suites of rooms exclusively set apart for the testing of hearing with elaborate nearly soundproof rooms, great installations of expensive audiometric equipment and a staff of trained technicians headed by an audiologist. These elaborate schemes have arisen from the belief that the testing of hearing is passing from the hands of the practicing otologist and will be confined strictly to expensive hospital departments devoted to the testing of hearing

In many of these a considerable hospital distance separates the hearing suite from the otologic clinic In some there are peculiarities such as the following visits by any otologist may be infrequent, the hearing establishment may be run exclusively by the audiologist, his special assistants, his technicians and his nurses, in the ear, nose and throat clinic there may be no provision whatever for the testing of hearing by the clinical otologist, and the latter may depend entirely upon the reports sent from the audiological department

The testing done in some of these departments is most elaborate and time-consuming — so much so, that in very few is there one attending otologist who is capable of performing the tests and in the majority there is no otologist who could afford the time involved

Audiological Work-Up Tests Without Validity in a Clinic

Many new hearing tests have been described and some of them strongly supported Every audiological clinic has a formidable list of tests

Guild[2] says "At least 10 to 12 hours of time per patient would be needed to administer all the hearing tests now regarded by one or another investigator as of interest and value The apparatus to make possible the administration of these tests would cost a minimum of several thousands of dollars This figure does not include the cost of the special rooms needed for satisfactory use of the testing apparatus, nor does it include the salaries of specially trained technicians to use the apparatus, or payments to skilled electronics engineers to keep the various pieces of apparatus in proper operating condition"

The supposition that these tests are of clinical value is not correct

In a lawsuit a physician stated he had done all the tests This drew the sage retort that a medical man who would do all the tests would be either naive or unscrupulous A wise and skilled medical man should perform only those tests which he knows will add to the knowledge of the patient's troubles, which are reliable and which are valid

Knowledge of any part of the body is based upon a correlation of function with the gross and microscopic appearance Real knowledge regarding hearing defects depends upon evidence from innumerable cases for which there has been adequate history, painstaking examination, accurate hearing tests, plus descriptions of the gross and microscopic pathology

The amount of such material available for critical study is not great and few teaching centers possess any whatever The evidence from a very good source of information is that 'histopathological evidence does not exist to support any of the hypothetic interpretations that have been proposed as explanations between functional differences observed in the fitting of hearing aids on persons with otherwise similar degrees and types of deafness "[3]

Guild[4] has written three condemning paragraphs which have not been controverted

"The information obtained from the elaborate tests or batteries of tests is primarily of research interest. Until the significance of the data obtainable by these tests has been evaluated in terms of lesions that otherwise would be overlooked or in terms of therapy that otherwise would not seem indicated clinical otologists should not be urged to use them or made to feel they are out of date if they do not.

In other words it is time for a clear distinction to be made between tests for research purposes and those for clinical purposes Nothing is gained clinically by the making of hearing tests that cannot be interpreted with reasonable certainty in terms of causative lesions

'All too often, a diagnosis, so-called, amounts to nothing but a statement of the kinds of hearing defects found by the tests made Such a statement no matter how elaborate the battery of tests used or how detailed the report of the data obtained is merely a description and not an interpretation of hearing tests and has no medical usefulness whatever

The establishments which I have criticized have a place in any institution devoted to research into problems of hearing and of psychology, but are unnecessary in a doctor's office or in a hospital clinic In these, there should be facilities which provide data that may be used for the good of the patient and the information of the otologist A hospital clinic may have a research unit attached to it, but, as this unit cannot provide the information which the clinic and the otologist require, it is not necessary for hospitals to provide it, unless the hospital can afford the extravagance of personnel for a research program

Interference with Clinic Is Wrong

A great research unit and its personnel must not be allowed to interfere with the necessities of the hospital clinic

Essentials for a Clinic

The essentials of a satisfactory method of mechanically measuring the hearing are — accuracy, quickness, and a technique which can be exactly repeated at a later date The apparatus should be as simple as possible, rugged, not likely to get out of order, and constant in performance

Restoration of Otologist to His Proper Function

I believe that the hearing facilities should be in the ear, nose and throat suite and that they should be such that any of the attending staff — providing he trains himself to operate the machines — can, when he desires, test the patient in whom he is interested I do not believe that the day of the otologist is over

Plan at the Hospital for Sick Children

We have tried to provide such conditions at our new hospital in Toronto in the following way

Our out-patient clinic has been so designed that the entire suite of rooms is at the service of the Hard-of-Hearing Clinic every afternoon Certain of the rooms are available to the Hard-of-Hearing Clinic every morning

The suite consists of five examining and treatment rooms, a hearing clinic room with an adjoining observation gallery, a hearing test suite consisting of an anteroom and two nearly soundproof rooms, a research room, a secretary's office, an office for the chief of service and a small waiting room

Our work roughly consists of the following interviewing the parent, the taking of an adequate history, the physical and special examination of the patient, the estimation of the patient's hearing, and if treatment is possible, the provision of this treatment. Whether treatment is feasible or not, the parent is given detailed advice regarding the home care of the child, and the patient is referred to the best available educational instruction

The work is carried on by two members of the staff, three Fellows, a secretary and the chief of service. We expect to obtain an experienced teacher of the deaf

The clinic has been placed next door to the social service department and across the hall from the department of psychological medicine and the speech clinic, with all of whom we work closely in the follow up of our patients

Our hardest problem is the testing of the hearing of children 12 months to three years of age In the hearing clinic room, little children who are extremely hard-of-hearing are examined with special testing devices These are the Peep Show, the Melody Master and various game-methods

Our Peep Show was evolved from the thumbnail sketch which accompanied an article by Dix and Hallpike[3] in the *British Medical Journal*, Nov 18, 1947 From that we built an apparatus which would produce a sound when a child was looking at a picture through a peephole and provided a screen, behind which the apparatus and the operator of the machines were hidden. This original model required two or more workers to handle the machine and child

During the evolution of our final model I visited Dr Norton Canfield, of New Haven, and received his generous help I did not copy his machine but I did adopt his excellent idea of centralizing all the mechanism on one control board Only one operator is required to handle our machine and the patient.

In this Peep Show we can use either a colored movie or colored still pictures We find that the movies captivate most of our little patients, but occasionally a very timid child has to be tested with our set of still pictures

Our second device for interesting children in sound is a Melody Master, which consists of a gramophone, headphones and microphones The children gradually are persuaded to wear earphones through which they hear any gramophone record which suits our purpose The mother assists by using a duplicate set of headphones and by endeavoring to speak to the child through a microphone The method is of only slight value at the initial visit but is very useful after the child has been attending for a number of weeks It is a pleasurable way of teaching the child to use earphones, for until this has been achieved the child cannot be tested with our speech audiometer

A much smaller portable microphone and headset is available for demonstration to parents who desire such apparatus for use at home in the instruction of their child

We have also many animal toys and peg-toys which can be be used to demonstrate to the mothers game-methods of conditioning their little deaf children to various sounds All of these games are similar in their basic purpose, which is that by means of a slight reward the child learns that a funny stimulus it receives (namely, sound) has a meaning

These four schemes arouse no antagonism or fear The time consumed in testing is sometimes great, but in the end it is rewarding

Special cupboards contain toys for the amusement of the children and the various forms of printed advice for the guidance of parents Gradually we hope to acquire such a number of pamphlets and forms that we can meet the problems of any parent

We advise parents of very young children to take the correspondence course of the Tracy Clinic

Hearing Test Suite

Two heavy doors make the hearing test suite soundproof except for very extreme noises Ordinary noises in the adjoining rooms and halls and outside do not in any way interfere with the patient or examiner

Two windows of unique construction look from the anteroom into the hearing test rooms Through these an observer in the anteroom can see all that is going on in the hearing-test room without those inside being aware that they are being observed

This has great value in allowing an observer to learn how various hearing tests are performed, and a parent to see exactly how its child is being handled, without the child being distracted by the person in the anteroom

The first hearing-test room has in it a double set of instruments One set, consisting of a high-fidelity gramophone audiometer and a pure-tone audiometer, is for the use of the clinicians. The second pure-tone audiometer and a much less expensive gramophone audiometer are for the use of the young doctors who are learning how to do hearing tests Masking is always used

The second hearing-test room is smaller than the first and contains two instruments a pure-tone audiometer and a special gramophone audiometer These are for the use of the chief of service and his assistant.

We use three types of audiometers The pure-tone audiometers are the last designed by the Western Electric Company They are the best of their type and are known for their simplicity, reliability and durability The special gramophone audiometers are instruments of unusual fidelity and were specially designed in Prof Solandt's department in the School of Hygiene, Toronto They are simple and accurate and full directions are provided so that any member of the clinic can operate them These machines probably will be able to play any type of gramophone record which may be devised The third machine is the Baldwin Gramophone Audiometer,— a recently marketed elaboration of the old 4-A Audiometer

In our research room, we have a duplicate of the Johns Hopkins' skin resistance machine for the testing of the hearing of young infants One of our Fellows is engaged in a three year investigation of the Baltimore claims

All of these physical facilities are close to rooms where every type of clinical examination and treatment is available The otologist who is to examine and treat the child and advise the patient is expected to attend every step For the child must learn to trust him implicitly

Statements Regarding Techniques

Now I must direct your attention to certain details regarding technique which we find of great importance in the testing of children's hearing

Re Pure-Tone Testing

To obtain results when testing the hearing of a very young child, the child's apprehension must be removed, his interest aroused and his cooperation obtained and held

This is difficult to achieve when using the pure-tone audiometer, — for the child has little interest in pure-tones

The commencement of pure-tone testing is done with the Peep Show It is an invaluable first approach The child can operate it without instruction. The picturesque little house at once disarms the child's fears and arouses his curiosity He naturally looks into the doorway — but he sees nothing for the black hallway is in darkness, however, what is a doorbell button for but to be pressed? The result is a pleasant discovery A picture appears which is moving The moving pictures of farm activities are pleasing and have dramatic attention holding appeal The desire to see what comes next keeps the child's cooperation. When his little arm is too weak to press the doorbell button the patient can rest his arm on the ledge and press the doorstep

Over the doorway is a small red fanlight and behind the gable decoration is a loud-speaker When the child presses the button a flashing light appears in the former and from the latter comes a musical tone synchronous with the flashing light. The light and the sound can be altered at will by the operator

Four discrete frequencies—500, 1,000 2,000 and 4,000 c.p s —are provided The rate can be varied and also the relative lengths of the off and on periods

In this test the child learns that when he responds to the flashing light by pressing the button he is rewarded by a continuation of the pleasing moving picture and also that when the light is not flashing, pressing the button produces no picture.

While this lesson is being learned, the operator is experimenting with different intensities of the four available sounds The control board can be operated without the child s being aware of it. Sometimes the child will suddenly investigate the gable, thus betraying the fact that he has located the source of the sound Sooner or later the operator switches off the light and in a favorable case the child continues to press the button whenever the sound is being produced

The child has discovered that a certain peculiar sensation has a meaning, that, if, when he perceives that sensation, he presses the button, he will get the reward of more pictures The pleasure the child gets is evident to all the observers and frequently brings tears to the eyes of the mother, who up to that point has believed her child could not hear The child has discovered that sound has a meaning and hope has been kindled in the mother's heart

The doctor, on the other hand, has formed a rough idea of the degree and extent of the hearing loss by having observed the intensity of each note that has reached the child's intelligence A very rough audiogram for four tones can be obtained in some cases

This happy result can be the early stage of pure-tone testing for the little patient If we had proceeded differently and had introduced the child to the pure-tone audiometer we would probably have aroused resentment and fear, for a child is not attracted by the uninteresting sounds of a pure-tone audiometer

To keep the child's attention it is necessary that there be as few distractions as possible As a rule, no one else is in the room except the child and the otologist, however, it is often necessary that the mother sit beside the child Observers are accommodated in the observation gallery where they can hear and yet are not seen

Testing Older Children with Pure-Tone Audiometer

We do not attempt testing a child with the pure-tone audiometer until much later in its clinic life We do not use it until the child's fears have been eliminated, until it trusts and obeys its instructor

In using the pure-tone audiometer we have given up having the patient press a button The action is distracting and takes time We have the child raise his finger when he hears the tone and drop it when the sound ceases The child sits with his back to the examiner and the latter watches the action of the finger and from it judges his patient's interest, attention, cooperation and alertness the air of the room as well as changing it frequently. He urges specially equipped centers in all large cities with specially trained staffs always available for treating burns.

The exposure method of the treatment of burns, Kyle and Wallace[9] argue has the advantage of simplicity. Their figures would indicate better results with exposure than with pressure dressings but the depth and extent of the burns have not been included as factors for comparison. An important adjunct to the exposure method is the immobilization and elevation of the burned part to limit edema.

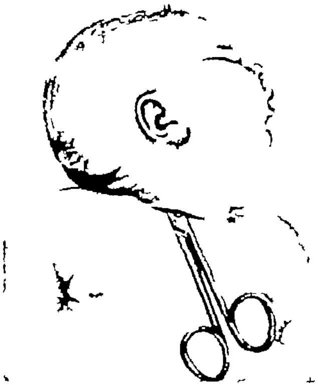

Fig. 1

A method is described by Kyle and Wallace[10] for estimating fluid requirements in burned children based on consideration of the extent of the surface area involved, the depth of injury, the normal blood volume of the patient and the normal metabolic requirement for the age and weight. The use of tables is required for application.

Two types of electrical burns are distinguished by Lewis, namely those from contact and those due to an arc. In either

We bother not at all with speech tests performed with selected test lists designed to show up losses of hearing in different parts of the frequency range The best way to test frequency hearing is to use frequencies as stimuli One cannot infer what speech hearing is from an audiogram

We make all tests very short. The time cannot be stated exactly A young child ought not to be in the soundproof room longer than a few minutes at a time Loss of interest on the part of the child will be shown in the gradual drooping of the signal finger, the delayed response of the finger, the swinging of a foot, etc. As soon as the child's interest or cooperation flags, we stop the test and leave the room

Re Speech Testing

Our testing of speech is simple We are not convinced that any of the newer and more elaborate methods of using speech in the testing of hearing are applicable to as wide a variety of patients as is the simple phonograph test

We use the high-fidelity gramophone and the Western Electric recording K S 6091, popularly known as the fading-numbers record The patient replies not by writing but by speaking the numbers he thinks he hears

By use of this record the child hears words with which he is thoroughly familiar This record played on an ordinary gramophone cannot be used to test patients who have more than 30 db loss of hearing As many of our patients are more deaf than this, amplification must be used Our high-fidelity machine enables us to use this record to test patients with a loss of as much as 84 db It has excellent attenuators, but we believe that the use of these in measuring hearing is inferior to the use of attenuation done in the recording

We are convinced that a more useful estimation of hearing can be obtained by testing a young child with speech than by testing him with pure-tones We are satisfied that numbers are superior to common words and sentences Nonsense sentences and meaningless speech sounds we have altogether discarded

Things We Do Not Perform in Testing Children's Hearing

We do not use any test which cannot be performed in a very few minutes and be repeated exactly many times on different occasions, any test which does not command the child's interest frightens it, does not arouse its cooperation, or fatigues it We have no use for watch tests, whisper tests, tuning fork tests or the monochord

We do not use speech audiometry to check the validity and reliability of other hearing tests Speech reception thresholds and discrimination scores have no value whatever in the testing of children's hearing Diplacusis measurements, tinnitus matching, recruitment evaluation, loudness balance, pure-tone averages and practically every other test to be found on audiological work-up charts are useless in the testing of children

Older, very intelligent children sometimes require modification of our regular testing technique, as also do young mental defectives The amount of masking varies These modifications are not stereotyped but are made on the spot by the otologist The latter is qualified to do so, whereas an audiologist would not be

What We Aim for

Our aims are an accurate and authoritative measurement of the child's hearing and a determination of whether his deafness is reversible or irreversible, therefore, we endeavor to use tests which we can repeat exactly, and also to use only those tests which we believe give us practical information

Condemnation of Loud-Speaker Free-Field Testing

Except in special cases, we advise against the use of loud-speaker free-field testing in any hospital clinic devoted to the hard-of-hearing — and especially in such a clinic for children

This advice will cause amazement, because this scheme is the predominant feature of nearly every such establishment set up in recent years

A hospital clinic is not a research unit primarily A hospital clinic exists for the good of the patients and the otologists who serve them A hospital clinic requires facilities for diagnosis and for comparative retests

Nearly every technique in use is inaccurate to a degree — but this technique is much more inaccurate than most — and should not be used for these purposes

The first important fault is that it makes use of live voice Speech is influenced by the breath stream from the lower respiratory tract, modulated by the vocal cords, varied by the articulators (lips, jaw, tongue and soft palate) and its overtones are selected and suppressed by the vocal cavities (nasal, oral and pharyngeal) The whole process is governed by the brain It is obvious that these basic speech processes cannot produce the same sounds for a second testing of the hearing for measured comparison unless they are in the same physical condition and are used in exactly the same way Even if a very practiced technician can, with the help of a voice-level-meter, learn how to control the intensity of his voice to an error as low as 3 db, that does not make it possible for him to make his tests constant in intensity for more than the same day, nor does it prevent him, six months later, from having got out of his bed on the wrong side, or from an intimate sorrow upsetting his laryngeal control, etc. With such things to contend with, his testing procedure, six months hence, may not be the same as it is today

That this contention is valid can be demonstrated visibly to anyone who visits the Western Electric research unit.

There can be seen in operation a large speech translator which throws speech on a moving phosphorescent plastic screen so perfectly that observers can read it. The speaker uses a voice-level meter to help him maintain as even an intensity of speech as he can

The visible speech patterns vary not only with the intensity but also with the pitch and with the timbre.

The effect of these on the visible patterns of speech can be quickly discerned by a study of the illustrations in "Visible Speech"[6] There, too, can be seen the variation in the visualization of the same sentences and the same words It will be apparent that the sound pattern of speech continually changes

The next disturbing fact is that all words spoken naturally and in sequence do not have the same physical power In addition, even when carefully monitored to the same effort of speech, all words are not equally intelligible

There are other difficulties in loud-speaker free-field testing The acoustic properties of the soundproof room in which the loud-speaker is used are amazingly difficult to keep constant for subsequent testing everything in the room must be exactly the same as was used at the previous test and in exactly the same position,—the patient must wear the same clothes, if not, the Western Electric Company has proven that the tests are not comparable

The obvious conclusion is that live-voice testing for *measurement* is a delusion

When one contemplates the many thousands of dollars which have been expended in such units and in paying the salaries of the required personnel, one wishes for the tongue and pen of a Jonathan Swift

Necessity for Recorded Testing Material

The consequence of this, namely, that live-voice must not be used, is that the testing material should be recorded The present materials are phonograph record and sound tape

Both phonograph records and sound tape are subject to wear and tear They cannot be expected to retain their fidelity over an extended period of time, but the "master" can be expected to keep its accuracy for years and from it fresh records can be stamped *ad infinitum*

Many recordings are at present available on various materials Your clinic, your hospital, your office is under the necessity of choosing one of these and laying in such a stock of them that your patients for many years to come may be tested by the same testing material under identical conditions

All of the recordings I have studied have defects, but I am sure there are many I have not seen or read about I am confident, however, that the clinical testing of the future will not be done by live-voice but by recorded speech This may be phonograph record or tape record The ultimate standard of either of these may not be established for some years to come. The point, however, is that the testing material will be a recording of some sort, so that it may be reproduced many times accurately The tests done by such a method will be practical and the results will be comparable

At present, in spite of its defects, I use in my clinic, Western Electric recording K.S 6091 * This is popularly known as the fading-numbers recording (I find the later record, Western Electric K.S 10087, less desirable)

It is the opinion of Hallowell Davis[7] (p 140) that the use of the list of numbers in the Western Electric fading-numbers recording, properly administered, is a measure of the hearing loss for speech of the same precision and reliability as the pure-tone test of a clinical audiometer

Criticisms of Our Scheme

Having criticized other methods of testing hearing, it is proper to note the imperfections of the schemes I advocate.

The faults of the tape recorder are as yet unknown and will not be properly known until it has been in use by otologists as long as gramophone records have been used

The audiologist criticizes the fading-numbers test thus. The recording can be obtained only on the old hard type of recording surface, which produces objectionable noises, both available recordings have certain imperfections which considerably annoy the tester, the relatively few combinations of the digits make the use of the fading numbers record most difficult to use in rehabilitative work because the short test lists can be memorized, it gives little or no information about discrimination

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* The attenuation in the Western Electric K.S. 6091 is in decibel notation.

The answer to these objections originates in the totally different viewpoints of the audiologist and the otologist The latter is a physician, the former is not The latter is interested primarily in his patient's satisfaction and well-being, the former is academic and interested primarily not in clinical research but in scientific research

The surface noises, providing they are minimal, the loss of fidelity from wear, providing replacements are readily obtainable, the imperfections in the recordings, the memorizability of the lists, and the testing of discrimination are venial faults They are all capable of improvement by alteration They are as nothing compared with the value the records possess of being useful for comparative retesting

It matters nothing to the audiologist whether a patient's hearing for speech improves, remains stationary or becomes worse, but to the patient and to the otologist these mean everything

In some states, in the screening of the school population the fading-numbers test is being replaced by a pure-tone audiometer test because of certain supposed imperfections of the fading-numbers test These are loss of validity because the children, thinking it is some sort of school examination, are very apt to cheat or try to copy from each other, the method fails to detect early high tone deafness, the diagnostic curves show a lesser degree of accuracy than those of other testing methods, the operation of the test usually disrupts the entire class and too many repeats and referrals are required

The advantages of the pure-tone audiometer for screening (which I personally doubt) are said by the protagonists to be greater ease of operation, it is possible to command individual attention without interference from other children, the diagnostic curve shows greater degree of accuracy, it enables a trained technician to examine an entire class with much greater speed than is possible with other methods and 20 to 30 children can be tested in both ears within an hour by sweep testing

It matters not to us as otologists which of these methods seems to prove most practical for screening in schools Our interest is entirely that children with incipient hearing impairment should be discovered so that appropriate steps may be taken early for their improvement. I will be glad to see the old screening method disappear from the public schools because the faults found with the fading-numbers test in school screening have been responsible for the lack of recognition of its very real merits

The otologist is keenly interested in every test which brings him information which he can use for his patients' improvement. The great mass of the tests now used in audiology are of no use to him His crying need at present is for a method which will provide data which can be compared with re-examination data of patients as they return As I have inferred above, I believe that he can obtain this by using Western Electric K.S 6091 in a high fidelity reproducing unit

The Hearing Aid Problem

A hospital hearing clinic may be asked to choose to recommend and to evaluate hearing aids, however, it is debatable whether any hospital should undertake this Because of its commercial significance such work is surrounded by pitfalls which will not be enumerated here In my opinion a great hospital, and much more a great university, should have nothing to do with it

Every large city should endeavor to obtain unbiased hearing aid service for the ever increasing multitude of hearing-aid wearers In New York City such work is performed admirably by the New York League for the Hard-of-Hearing a partially voluntary organization In Great Britain such service is obtainable in innumerable cities and towns

There are many hard-of-hearing children who are benefited by hearing-aids, and undoubtedly there are many more who could be Every large city should provide classes designed to prepare children to wear hearing-aids Until voluntary organizations or boards of education provide these, a children's hospital may be required to make provision to do this It is, however, service which requires much space and special teachers, and it is debatable whether a hospital is the proper place for such work

Need for a Teacher of the Deaf

It is, however, certain that a hospital for sick children should employ an experienced teacher of deaf children

It is commonplace that very few mature adults attain proficiency in lipreading, but those who work with little children know that the child of four or five learns to lipread very easily if he is intelligent

It is the growing recognition of this that has led to the institution of preschool classes for the hard-of-hearing In Toronto we have only one such class Hence to a hospital for sick children will come mothers of children of preschool and younger age, not only from the city but from nearby municipalities and from all over the province We hope to encourage such a mother to stay in Toronto for a long enough period to obtain instruction from our teacher on how to conduct herself with her child at home Many an intelligent mother will learn to teach her little child to lipread with immense benefits to the child

I believe that a well-trained, well-educated teacher of the deaf is indispensable for a hard-of-hearing clinic for children It is all important that the one chosen should understand and love little children She has to demonstrate patiently to the children and to the parents the fundamentals of how remnants of hearing can be utilized in the future education of the child, for it is the very early years of a child's life that are all important The sphere of influence of such a teacher is very great

Regarding Permanency or Irreversibility of Perceptive Lesions

It is service to the little hard-of-hearing child that is the all important object of testing and examining it. The purpose should not be to decide whether or not an operation can be usefully undertaken by a fenestrationist Consequently the location of the underlying lesion in the perceptive apparatus is not of prime importance

As a heritage from the past, otologists make their first diagnostic objective the determination whether the lesion responsible for the deafness is or is not in the perceptive apparatus Because there are obviously irreparable lesions of the internal ear, the assumption is made that every lesion of the perceptive apparatus is irreversible and, therefore, incurable Having made such a diagnosis, any attempt to ameliorate the condition by treatment is considered futile and even dishonest.

We ought to know better There are many lesions of nerves which recover There are lesions of the optic nerve which recover In disseminated sclerosis a degree of recovery may occur spontaneously and persist for many years A large scotoma may diminish in size until it is almost completely gone Multiple sclerosis and pernicious anemia are the two most common examples of demyelinating diseases where recovery can occur providing the axis cylinders have not been damaged to an irreversible degree Hyland, Watts and Farquharson[9] in a long study of pernicious anemia patients have reported improved functioning of reversibly affected fibres in the tracts of the spinal cord due to maintenance of adequate therapy

It is, therefore safer to assume that lesions of the perceptive apparatus of the ear are in their early stages at least, reversible and amenable to treatment.

Let me give you an example a six-month-old patient of ours was a candidate for adoption There was no evidence of any hearing and no ocular response to douching with cold water We advised against adoption, and as our findings remained unchanged we continued to do so At 18 months, because its attempts at babbling were not flat and toneless, we said there was still hope At the age of two years and one month the child commenced to put three and four words together

We are in the infancy of an understanding of the problems of perceptive deafness

We must be very slow in saying that a child who apparently has a serious perceptive lesion cannot recover

As a corollary to the above assumption it is commonly believed that a lesion of the conduction apparatus is usually amenable to treatment It is, however, easy to find in the literature pictures of fully organized deposits in the middle ear which are irreversible and incurable

We should, therefore, stop concentrating on lesions of the internal ear and instead we should devote our attention to finding variations in the patient's hearing Variation can occur with both conductive and perceptive lesions If the hearing really varies, the underlying lesion is not yet permanently fixed and should be amenable to treatment At present there is no test which demonstrates variability as effectively as the speech test

Attention to Treatment Essential

Children have immense powers of recovery and the otologist who finds variation in a child's hearing should be medically minded and not surgically minded

The number of patients whose hearing is defective because of a congenital lesion is small The vast majority are hard-of-hearing because of disease, usually infection It is of fundamental importance that the otologist recognize the earliest signs of the disease and arrest the process at that stage if he can He must watch the progress of the patient by measuring the hearing of the young child, a procedure which this paper has shown to be very difficult case it is important to treat them conservatively in the early stages The severity is often more dependent on the conditions of contact than on the nature of the current

Entin and Baxter[12] conducted experimental, graduated and controlled thermal injuries on normal human skin They decided that clinical evidence of vesication and coagulation are of little value as criteria by which to determine the depth of injury in cases where neither the duration nor the severity of exposure to heat are known It is concluded that microscopic sampling is imperative for early estimation of depth of injury

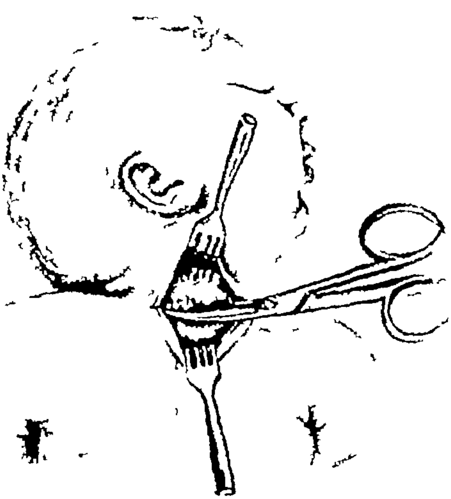

Fig 1B

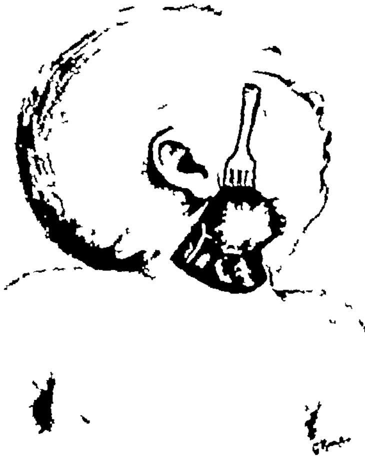

Fig 1C

Observations of Baxter and Entin[13] on prolonged exposure to moderate cold in man suggest that increased vascular permeability is due to direct damage of the smaller vessels Early administration of heparin is believed to assist lymphatic circulation by way of preventing coagulation in the tissues and thereby reducing fibrosis,, however, in actual freezing of human tissue, all the cells are damaged directly and anticoagulants cannot repair the vascular tree in these cases

One otologist, whom I admire, has written that the testing of the hard-of-hearing children and their future handling should be the audiologist's task. It is my opinion that the audiologist will never be fitted to do such a task

Visit any clinic you will, and you will be impressed by two things the time devoted to audiologic technique and work up is very great, much attention is given to the education of the parents by the audiologist, but the time devoted to history taking, examination, and treatment of the child is brief

This is not as it should be The most important part of all and the part that *should* be great is the estimation of the child's hearing ability by the otologist and his continued attention to the problem

The measurement of the hearing in the very young child is extremely difficult and requires suitable techniques, but it is of fundamental importance because it is the indispensable index to the results of treatment.

Deficiency in hearing is caused in a small percentage of the population by defects present at birth. In the vast majority of instances, however it is caused by disease, which itself has a beginning

The defect in the hearing of an adult in many instances has been present so long that it is irreversible. The adult's defect should have been arrested at its beginning in childhood

The treatment of suppurating ears in children should not be passed over to a nurse or young doctor, for the younger the child the harder the problem of treatment It requires the care and perseverance that only an older otologist who is impressed with the responsibility of his task can give

It is the ambition of this clinic of the Hospital for Sick Children of Toronto so to arouse the medical profession that early attacks upon the hearing apparatus of the young child will be arrested and the changes that have been produced will be wiped out while they are still reversible

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BILATERAL MIDLINE PARALYSIS OF THE LARYNX OF CENTRAL ORIGIN

ITS OCCURRENCE AS A POSTOPERATIVE COMPLICATION *

A F JUDGE, M D ,
Martinsburg, W Va

Bilateral midline paralysis of the larynx following surgery on a part of the body other than the thyroid is alarming because it is unexpected It is serious because of the pulmonary complications which follow

The author first observed a patient with such a paralysis in 1946 The patient following section of the trigeminal nerve for tic douloureux, developed dyspnea, stridor and occasional cyanosis, on the afternoon of surgery Direct examination of the larynx revealed the vocal cords immobile in the midline. A search of the literature at that time showed the only reference to such a postoperative complication to be made by Jackson.[1] He stated that bilateral incomplete paralysis of the larynx had been observed as a transitory condition after operations in regions remote from the thyroid—in two instances following abdominal surgery It was assumed that the paralysis was caused by intracranial disturbances, probably circulatory

Interest in the condition has been reawakened by our encountering three additional cases during the past two years

Etiology — The sudden appearance of the paralysis and the bilateral involvement led to the conclusion that the causative lesion is a vascular one located in the medulla The possible lesions are spasm, hemorrhage thrombosis and embolism

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From the Department of Otolaryngology Veterans Administration Center

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Behrend and Riggs[2] state that cerebral complications following surgical operations are not rare, and found such complications were seldom the result of embolism or hemorrhage

New and Childrey,[3] in a study of 217 cases of paralysis of the vocal cords, found 24 which were central in origin Four were due to hematomyelia and one to thrombosis of the medulla Three of the 24 cases were bilateral abductor paralysis

Work[4] described a patient who presented clinical indications of multiple, small cerebral thrombi Bilateral abductor paresis of the vocal cord was noted Examined at a later date, the patient showed complete recovery

Cody[5] examined a patient with sudden onset of paralysis of half the soft palate, half the tongue and abductor paralysis of one vocal cord Re-examination seven hours later showed that all the structures were no longer paralyzed He attributed the transient paralyses to vasospasm in the medulla He enumerates thrombosis of the arteries supplying the medulla and vasoconstriction of the radicular arteries to the motor nuclei as vascular conditions causing the laryngeal syndrome of the medulla

King and Gregg[6] list cerebral hemorrhage as a cause of laryngeal paralysis

Location of the Lesion — Bilateral midline paralysis of the vocal cords is produced by involvement of the abductor fibres in the inferior laryngeal nerve of both sides Corticobulbar fibres carrying impulses to the lower motor neurons, which supply the larynx, arise in the pyramidal cells in the precentral gyrus of the cerebral cortex They pass downward through the internal capsule to the medulla, where they undergo partial decussation and terminate in the nucleus ambiguus around cells of the recurrent and superior laryngeal nerves, thus, impulses brought to the cells of origin of the recurrent nerve on one side arise from the cerebral cortex of both sides

Furstenberg[7] points out that a lesion above the nucleus ambiguus will produce laryngeal paralysis only if large enough to affect the corticobulbar fibres on both sides The paralysis would then be bilateral and spastic

Jackson[1] points out that at, or near, the partial decussation of the motor fibres, a small lesion can reach the upper motor neurons of both sides and thus produce a bilateral motor paralysis of the larynx. Such a lesion, being above the nuclei ambigui, would be spastic in nature Work[4] believes that spastic paralyses of supranuclear origin are often missed, especially if transient and incomplete Furstenberg[7] believes that unilateral lesions are overlooked because of the slight impairment of laryngeal function, but that bilateral paralysis causes such a profound disturbance that a laryngologist is promptly consulted

In the medulla, the nuclei ambigui are not far apart and the same is true of the recurrent laryngeal nerves, hence a lesion here may cause a bilateral laryngeal paralysis Such a lesion produces a flaccid paralysis

Cody[5] points out that the radicular arteries supplying the nuclei ambigui are long and slender and more exposed to vascular disorders. They are more frequently affected than other vessels of the medulla

Woodward[8] points out the close association of the nuclei of the glossopharyngeal, spinal accessory and hypoglossal with the vagus nucleus in the medulla and the resulting frequent association of paralyses of these nerves when the vagus is involved

Cody[5] and Furstenberg[7] also stress the fact that central lesions causing laryngeal paralysis frequently involve the IXth XIth and XIIth nerves in addition.

King[6] states that he has seen no laryngeal paralysis resulting from a central lesion that was not associated with paralytic disturbances of the muscles of the pharynx and tongue, and frequently with motor disturbances remote from the larynx however it must be remembered that vascular lesions sometimes cause transitory paralyses and the finding of associated paralyses will depend upon the relationship of the time of examination to the time of onset of the lesion

Pathology and Pathologic Physiology—Behrend and Riggs[3] studied the protocol material from 21 patients who had cerebral complications following surgical operation Five of these patients had shown symptoms of focal paralysis In every case the brain showed generalized capillary damage with widespread parenchymatous degeneration due to pericellular and interstitial edema In eight patients, who had survived the operation from two to nine days, there were focal areas of glial and phagocytic activity suggesting beginning repair and scar formation Edema and congestion of the viscera were also observed The anesthetic had been ether in 12 cases, cyclopropane in four, nitrous oxide in three, and procaine hydrochloride for spinal anesthesia in two

These authors felt that the cerebral complications following surgical operation were due to cerebral anoxia resulting from acute circulatory collapse, precipitated by the administration of an anesthetic in persons with reduced circulatory reserve

Wilson, Rupp, Riggs and Wilson[9] studied 542 cases of cerebral vascular accident Their findings suggested that systemic circulatory inadequacy played an important rôle in the causation of cerebral vascular accidents

Hicks and Warren[10] state that the cause of virtually all cerebral vascular accidents (excluding aneurysm) is local ischemia This is true whether the lesion is hemorrhagic or nonhemorrhagic and whether or not thrombosis is present In a study of 100 cases of fatal cerebral infarction, a majority of cases showed no evidence of mechanical occlusion of cerebral vessels They conclude that vasospasm is the most common cause of the ischemia

Sherman and Grinker[11] stress the relationship of cerebrovascular accidents to diseases of the cardiovascular system They point out that, although there is a free capillary anastomosis within the brain, it is insufficient to maintain an adequate circulation in an area of any one artery which is occluded Although the evidence is not entirely convincing that cerebral vasospasm of sufficient intensity to occlude an artery can occur, they feel that, from a clinical standpoint, many cases of transient neurologic dysfunction are explicable only on such a basis

Occlusion of a cerebral vessel for as long as two minutes results in a parenchymatous reaction with interstitial edema hyperemia of neighboring vessels and reversible damage to brain tissue. The clinical signs of such a lesion may disappear within several hours or several days Longer periods of occlusion produce irreversible damage.

Pickering[12] credits Peabody, in 1891, with being the first to ascribe transient attacks of paralysis to spasm of a cerebral artery According to this theory, a cerebral arterial wall contracts, obliterating the lumen, the corresponding area of brain becomes ischemic and a corresponding localized sensory or motor paralysis ensues Pickering feels the evidence for vasospasm of cerebral arteries is slight He concludes that attacks of localized sensory or motor paralysis are due to edema of the brain. The edema is less likely to be due to constriction of the artery than to defective constriction

Houssay[13] states that CO_2 is the most powerful dilator of the cerebral vessels and that ether also acts locally on the cerebral vessels to cause dilatation Nervous disturbances of short duration have been attributed both to vasospasm and vasodilatation

From a review of the foregoing extracts we find that various authors agree that the basic cause of paralysis of central origin is local ischemia secondary to edema, that, if the paralysis is transitory, the local pathological lesion must be a reversible one, that long periods of ischemia cause irreversible damage to brain tissue and the resulting paralysis is of longer duration

There is, however, wide divergence of opinion regarding the basic pathologic physiology Some investigators feel that vasospasm is the primary cause Others attribute ischemia and edema to vasoparalysis and circulatory insufficiency associated with disorders of the cardiovascular system In rare instances it may be due to hemorrhage, thrombosis or embolism

Symptoms—As Jackson[14] points out, bilateral laryngeal paralysis is often overlooked This should be especially true in patients recovering from surgery who are on bed rest and sedation The outstanding symptoms of midline paralysis are inspiratory dyspnea and stridor The symptoms vary in degree and may appear only on exertion Usually the voice changes are slight

Complications—With the obstruction to pulmonary drainage caused by the immobile vocal cords, secretional obstruction soon becomes prominent In addition, if there is accompanying motor or sensory paralysis of the pharynx, the nasopharyngeal and salivary secretions find their way into the tracheobronchial tree to be added to the pulmonary secretions Gray,[15] Von Leden,[16] Galloway[17] and others have called attention to the seriousness of the accumulation of these secretions in the lower bronchial tree

With obstruction to the removal of secretions, reduction in the ventilation capacity occurs This leads to hypoventilation, retention of CO_2 in the body and an increase of CO_2 in the blood Hypoventilation also reduces the O_2 saturation of the arterial blood This disarrangement of the relative O_2 and CO_2 content of the blood soon brings about a change in blood pH A combination of these factors leads to asphyxia

In the early stages of such complications, patients show restlessness, apprehension and disorientation This may lead to further sedation and further depression of the respiratory center Two significant early signs are nonproductive cough and the presence of rhonchi in the chest

Usually at this stage the patient is treated by postural drainage, catheter suction and perhaps bronchoscopic aspiration In addition the patient receives O_2 therapy All of these measures fail to relieve the dyspnea and stridor for any significant length of time

If the obstruction continues, edema, atelectasis and pneumonitis appear

Diagnosis — If the laryngologist is consulted, mirror examination shows the cords to be immobile in the midline Therapeutic bronchoscopy for the aspiration of accumulated secretions may also reveal the diagnosis, however, unless the possibility is kept in mind, the endoscopist, in his anxiety to relieve a very sick patient, may overlook the paralysis since the bronchoscope is passed without too much difficulty into the trachea The paralysis viewed through the bronchoscope may be mistaken for a spasm of the glottis

The inspiratory stridor and failure of aspiration of retained secretions to relieve the dyspnea should suggest obstruction in the larynx itself

Differential Diagnosis — The important differential diagnosis in postoperative laryngeal paralysis is to differentiate it from obstruction that is due to simple retention of retained secretions. This is important because, while aspiration of secretions, postural drainage and administration of O_2 may suffice in the treatment of the latter condition, they will prove insufficient if the vocal cords are paralyzed

Abductor paralysis must also be differentiated from post operative edema of the mucosa of the larynx and of the hypopharynx Modlin[19] in discussing a paper by Gius and Grier, reported six patients requiring tracheotomy postoperatively following bilateral neck dissection with removal of both internal jugular veins This procedure was necessitated by alarming postoperative edema of the larynx. It was necessary to maintain the cannula in place for as long as three weeks postoperatively In one of our cases of laryngeal paralysis following bilateral neck dissection the paralysis was not apparent until the edema of the hypopharynx and larynx had begun to subside.

At times the reaction to an intratracheal tube used for anesthesia may confuse the diagnosis This was true in another of our cases which showed moderate ecchymosis and edema of the pharyngeal mucosa in addition to the laryngeal paralysis

During an epidemic of poliomyelitis, particularly following an emergency operation, it would be well to differentiate the bulbar type of polioencephalitis from abductor laryngeal paralysis

Treatment — The immediate treatment of bilateral midline paralysis of the vocal cords is tracheotomy The introduction of a tube into the trachea bypasses the laryngeal obstruction and in cases of associated paralysis of the pharynx, either motor or sensory, it lessens the danger of aspiration of secretions If the complication of secretional obstruction has already supervened, this condition is more readily treated by repeated aspiration through the tracheotomy cannula

The importance of treating the primary condition is emphasized by the findings of Ende and Ziskind,[10] who in a series of 137 consecutive autopsies found three postoperative deaths due to asphyxia from retained tracheobronchial secretions

Fortunately, the present day tendency is to treat all cases of respiratory difficulty due to retained secretions by tracheotomy if the condition is likely to persist for more than 24 hours This makes for ease of nursing care by personnel with no specialized training Thus, even if the diagnosis of a postoperative laryngeal paralysis is missed or delayed, the proper treatment would possibly be instituted on an empiric basis

The majority of cases of laryngeal paralyses that we have seen complicating surgery other than thyroidectomy, have resolved in from four to six weeks, however, if the paralysis persists longer than six months, it is likely that gliosis and scar tissue formation have taken place in the central area involved In such a case surgery on the larynx as devised by King, Kelly, Woodman and others may be necessary if the patient is to be decannulated

CASE REPORTS

Case 1 A female patient, past the fifth decade was admitted to a voluntary hospital in Albany, N Y, in January, 1946, because of trigeminal neuralgia Under general intratracheal anesthesia, a section of the Vth nerve was performed intracranially Shortly after recovery from the

Allen and Safford[14] found hypothermia was beneficial for burns in rats and also for frostbite after the frozen tissues had been rapidly thawed first

Parsons, Alrich and Lehman[15] studied the effect of heparinization on the amount of tissue loss in third degree burns and found its use somewhat helpful Brooks *et al.*[16] report the sludging of blood following severe thermal burns and note its deleterious effect

Moore *et al*[17] measured nitrogen, sodium, potassium and chloride balances in lightly and severely burned patients and found the exudate loss of nitrogen may constitute 25 to 30 per cent of total nitrogen losses during the period of maximum wound slough and purulent discharge The exudate sodium may comprise 95 per cent of all sodium losses with concomitant urinary losses reduced virtually to zero Chloride balance is similar to sodium but not to such a marked degree of extremes Braasch, Bell and Levenson[18] showed dissociation of nitrogen and phosphorus and of nitrogen and potassium excretions in burned rats

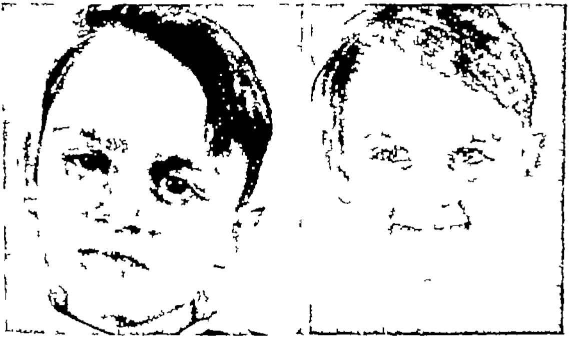

Fig 2 Congenital wryneck with complete rehabilitation by resection of the fibrosed sternomastoid muscle

anesthetic the patient had an attack of cyanosis. The anesthetist was called and he aspirated the tracheal mucosa and administered oxygen Because the patient had anesthesia of the pharynx it was possible to examine the vocal cords directly This examination revealed a bilateral midline paralysis of the vocal cords Because the dyspnea persisted with recurrent cyanosis a tracheotomy was performed on the same evening as the original surgery This relieved the patient's symptoms During the next few days the anesthesia of the pharynx disappeared and the mobility of the vocal cords returned within two weeks. The patient was then decannulated the tracheotomy wound closed by a plastic procedure and the patient discharged from the hospital.

Case 2 E. H. aged 66 white female was admitted to the Veterans Hospital for surgery of a recurrent carcinoma of the breast. Original surgery on the breast had been performed in February 1946 and followed in 1948 by irradiation. The patient had a systolic murmur in the mitral area but there was no cardiac enlargement. On Oct. 16 1950 under pentothal and intratracheal nitrous oxide anesthesia the lesion of the chest wall was removed and a skin graft applied On the second postoperative day the patient was examined because of dyspnea and stridor There was ecchymosis of the palate and swelling of the false cords. The true cords were not visualized Chest X ray showed no atelectasis. Two days later because of persistent dyspnea a direct laryngoscopy was performed and it was then found that the patient had a bilattral midline paralysis of the flaccid type Tracheotomy was performed which relieved the dyspnea By Nov 15 1950 the cords were moving normally on abduction and the tracheotomy tube was removed

Case 3 C. H aged 63 white male was admitted to the Veterans Hospital on Sept. 20 1951 because of pain in the abdomen of one week's duration. In 1945 the patient had suffered a compound fracture of the skull with damage to brain tissue This left him with a left hemiparesis Chest X ray on admission revealed moderate cardiac enlargement. Abdominal examination revealed an incarcerated mass in the right inguinal region. His blood pressure was 128/70 An emergency inguinal herniorrhaphy and appendectomy were performed on the day of admission under spinal anesthesia Late on the day of surgery a bronchoscopy was performed because of signs of retained secretions Two days postoperatively a chest X ray showed pneumonitis at the left base On the fourth day laparotomy was performed because of ileus Bronchoscopy was repeated at this time Chest X ray then showed atelectasis In spite of the administration of oxygen, the patient was dyspneic and cyanotic and moist rales were present throughout the chest The patient was confused and disoriented and for this reason was receiving sedation He had also been receiving antibiotics with no appreciable effect upon the chest condition He was coughing but failing to raise any secretion On Sept. 28 1951 he was seen in consultation by the laryngologist. Examination revealed weakness of the tongue and palate and a bilateral midline paralysis of the vocal cords. Tracheotomy was performed and a large amount of thick mucopus aspirated from the tracheobronchial tree The patient's condition improved remarkably within 24 hours both physically and mentally Five days later the patient was able to swallow nourishment. Within three weeks the paralysis of the vocal cords had disappeared. The tracheotomy tube was removed and on Oct. 17 1951 the wound was closed by a plastic procedure The patient was discharged to the domiciliary section on Jan 7 1952

Case 4 R. W., aged 68 white male was admitted to Veterans Hospital on Aug. 6 1951 because of a mass in the right cervical region. This mass had been present for seven months Ear nose and throat examination revealed an ulceration at the base of the tongue on the right extending past the midline Another cervical node was noted low in the left cervical region His blood pressure was 156/78 Physical examination and laboratory examinations revealed no other abnormalities Biopsy of the tongue ulcer showed squamous carcinoma Grade II Deep X ray therapy showed that the ulcer responded to irradiation On Sept 13 1951, seven radon seeds of 2 5 millicuries each were inserted in the tongue and on the following day under intratracheal anesthesia, a right radical neck dissection was performed There was moderate postoperative edema of the pharynx and right aryepiglottic fold however this edema and the irradiation reaction of the tongue gradually subsided The incision healed slowly because of the irradiation On Nov 13 1951 under intratracheal anesthesia with nitrous oxide and ether a left radical neck dissection was performed When the intratracheal tube was removed at the conclusion of the operation the patient became cyanotic It was impossible to reintroduce the tube because of the pharyngeal and laryngeal edema A tracheotomy was performed This relieved the cyanosis Postoperatively there was marked edema of the conjunctiva, pharynx, larynx and cervical region This gradually subsided Mirror examination of the larynx was made on Dec 7 1951 because of inspirational stridor and because patient had dyspnea when the tracheotomy tube was occluded This revealed a bilateral midline paralysis of the vocal cords Occasionally during the next two months the cords seemed to regain slight mobility however five months postoperatively with all edema of the face conjunctiva and larynx subsided the cords lie immobile in the midline and the patient can go only a short time with the tube occluded He also has much difficulty in raising mucus unless the tracheotomy tube is open Surgery for bilateral abductor paralysis of the vocal cords is now being contemplated

DISCUSSION

In Case 1 an associated paralysis of the glossopharyngeal nerve was noted when the patient was examined shortly after the onset of symptoms In Case 3 a paralysis of the hypoglossal nerve was also present No associated paralysis was noted in the other two cases, although such a condition may have existed temporarily

Case 2 illustrates well the pulmonary sequelae of obstruction with retention of tracheobronchial secretions It also shows the mental results of anoxia even when O_2 is being administered when the bronchial secretions are not being evacuated

In Case 4 it was difficult to convince the general surgeon that the obstruction was not due to local edema of the larynx and pharynx, however, the persistence of the bilateral paralysis after all edema had subsided seems convincing proof that the paralysis was central in origin

SUMMARY

Four cases of bilateral midline paralysis of the larynx occurring as postoperative complications due to central vascular lesions are presented Two cases showed associated paralyses In three cass the paralysis was temporary In the fourth case it has persisted over five months and appears to be permanent.

The pathophysiological possibilities are discussed

Tracheotomy for the treatment of the paralysis and its pulmonary complications is emphasized

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PERCEPTIVE DEAFNESS IN CHILDHOOD *

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There appears to be very wide variation in the available figures on the incidence of deafness in children Very roughly one may say that one in every 300 boys and one in every 400 girls are sufficiently deaf to require special schooling, and that of these the acquired, postnatal types have been approximately twice as common as the congenital Since both varieties are frequently the result of epidemic disease, statistics must vary considerably from time to time, and from place to place also, due to constantly improving public health services and epidemic control, acquired forms of deafness should, in time, be very largely eliminated Due to lack of precise knowledge, classifications of nerve deafness have mostly been unsatisfactory The table used in this presentation is similar in most respects to that recently suggested by Victor Goodhill

1 *HEREDITARY* (GENETIC)

- *A* Developmental Anomalies
  - Aplastic
  - Degenerative
- *B* Erythroblastosis Fetalis (Kernicterus)

2 *ACQUIRED*

- *A* Prenatal
  - *1* Infections (Rubello — polio — viral)
  - *2* Drugs
  - *3* Developmental (Metabolic — Endocrine — etc.)

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B Natal

- *1* Birth Injuries
- *2* Drugs (Quinine)

C Postnasal

- *1* Local Infections (Labyrinthitis)
- *2* Systemic Infections (Esp Viral)
- *3* Drugs (Streptomycin)
- *4* Trauma (Auditory and Gross)
- *5* Miscellaneous

1 Hereditary Deafness

A Developmental —

Familial deafness is transmitted according to the Mendelian pattern, involving a single recessive gene Its occurrence in the offspring of a deaf patient of this type depends upon the hereditary makeup of the spouse — thus the influence of consanguinity The presence of this type of deafness among the siblings, even if the subject has normal hearing, suggests that he is a carrier of the recessive gene for deafness

In developmental anomalies, there is either a primary lack of development or there is development up to a point followed by regressive changes It consists essentially of one or more anomalies of the cochlear duct usually associated with abnormalities of the saccule and rarely of the bony cochlea, the utricle or semicircular canals It is also often associated with other developmental anomalies such as feeblemindedness, retinitis pigmentosa, familial osseous fragility, and various bodily malformations

Complete deafness is rare In making the diagnosis, a clearcut history is essential in distinguishing this from other forms of deafness

B Kernicterus —

The second variety of hereditary deafness is of considerable interest at the present time The mechanism is briefly as follows

Persons are said to be Rh positive or Rh negative according to whether their blood contains Rh agglutinogen or not — 85 per cent of people being positive and 15 per cent being negative Rh negative persons are liable to develop antibodies — i e, against Rh positive cells — if Rh agglutinogen is introduced into the circulation This may occur in either sex as a result of transfusion, and in an Rh negative woman who is pregnant with an Rh positive fetus — the fetus having inherited the agglutinogen from the father It appears that the agglutinogen of the fetus enters the maternal circulation, thereby stimulating the production of the specific antibodies These in turn on entering the fetal circulation in sufficient concentration produce hemolysis Three degrees of this condition have long been recognized, namely

1 Congenital hydrops fetalis — the infant being either moribund or dead at birth

2 Icterus neonatorum in which there is complete jaun dice at or within 24 hours of birth.

3 Congenital anemia of the newborn

Unless a woman has been sensitized by transfusion the firstborn is likely to escape, due to lack of concentration of antibodies in the maternal blood, but the second, and still more the third, child is likely to be affected

The cerebral cortex and cranial nuclei are the areas chiefly involved Rh incompatibility occurs about once in 200 births

2 *Acquired Deafness*

A *Prenatal* —

1 Infections — Some years ago maternal rubella became suspect since when its rôle as the major single cause of infantile deafness has been steadily unfolding The cochlea develops from the sixth week until about the end of the fourth month The degree of deafness depends largely upon the stage of development of the cochlea at the time of onset of the infection Maternal rubella has been found to be the cause of 20 5 per cent of all forms of infantile deafness, and this figure is likely to increase (Goodhill)

As might be expected from the nature of the condition, deafness from this cause is frequently associated with other defects and malformations, including congenital heart disease, congenital cataract, harelip, club foot, microcephaly, hypospadias, spasticity, etc

It is a curious reversal of form that the other exanthemata, which can play such havoc with the hearing of infants and young children, seem to have little or no effect upon the fetal organism, however, another virus disease which has been found to have an unexpectedly high incidence as a cause of deafness is poliomyelitis — again when it occurs during the first trimester

2 Drugs — It is of interest to note that much experimental work has been done in animals on the effects of drugs on the fetal organs of hearing Investigators have reported that changes in the cochlea can be produced which are indistinguishable from those found in developmental deafness Some of the chemicals mentioned are calcium chloride, pilocarpine, guanidine, arsenic acid These findings would lead one to think that deafness from intrauterine toxic factors of exogenous origin may be more common than is generally suspected

B Natal — Birth Injuries — Drugs (Quinine)

C Postnatal —

Statistics indicate that this reaches a maximum during the first two years of life, after which there is a steady decline — becoming more rapid with each year achieved, however, from the point of view of therapy, there is nothing to choose between a young child who has been born deaf and one who has acquired his deafness within a year or two of birth Neither one can hear, and because of this essential lack, they are both quite incapable of speech without having special training

Infections — Inflammatory states in which the cochlea is invaded form a major cause of this type of deafness, and are generally the result of meningitis, the epidemic form being the greatest offender The mechanism is that of direct spread of infection from the meninges to the cochlea and vestibule by way of the VIIIth nerve and the cochlear aqueduct The contents of the bony labyrinth become replaced to a greater or less extent by the products of infection, which, with survival of the individual, become organized, and form granulations, and these in turn may complete the metaplastic cycle to become bone

Meningitis alone appears to be the cause of approximately half as many cases of deafness as maternal rubella It is closely followed by the virus infections — the exanthemata, however, it must be borne in mind that the majority of infections, both regional and systemic, are capable under suitable circumstances of causing deafness This usually affects the cochlea and only occasionally the VIIIth nerve, for, since the cochlea is phylogenetically the most recently developed organ of special sense, it is correspondingly the least well able to resist or to recover from any form of injury

Drugs — Many drugs have been implicated One of recent import is streptomycin Deafness from this cause is likely to be both permanent and severe. Recent investigations have shown that at least in some instances the lesion in streptomycin deafness is liquefactive necrosis in the ventral cochlear nuclei The effect of streptomycin appears to differ from that of dihydrostreptomycin

Trauma — Another small group, but one which is acquiring greater significance in this modern age, is that of deafness due to trauma. Briefly one can say that if the labyrinth is involved in the line of fracture, the resulting deafness will probably be complete, presuming that the patient recovers

If the temporal bone is involved but the labyrinth is not directly implicated, the degree and permanence of the ensuing deafness depends upon the amount of blood which invades the labyrinth and upon its subsequent absorption or organization

Much the same picture may follow concussion without fracture, and at times from a seemingly trivial injury

Age plays a definite part in this category in that the older the patient, the less hearing does he recover from his point of maximum deafness

Diagnosis As regards the *recognition* of deafness in children, it is interesting to note that it is more often the inability to speak than the inability to hear which is first recognized and for which cure is sought So much is speech a function of hearing that without proper training, every child who loses his hearing prior to the age of four years will most certainly become a deafmute, and this is likely to occur with loss of hearing up to the age of eight or even 10 years Another important sequel to the loss of hearing is that the older the child on suffering this loss, and the longer he remains without training, the more likely are personality problems to develop to the detriment of his rehabilitation The psychology of the deaf is peculiar, it produces an exaggerated sensitivity about their affliction with a tendency to withdraw, to irritability and to suspicion

In the very young the estimation of the degree of deafness is unquestionably difficult, but, as already indicated, it is more important to recognize at the earliest opportunity that there is deafness present than to name its type

Tests — Testing is of two varieties

1 The usual type in which the patient voluntarily responds to the test sounds and, —
2 Objective hearing tests in which the examiner is able to observe involuntary responses

The latter is, of course, the kind which has to be employed for infants The most accurate, but somewhat complicated, is probably Bordley's galvanic test in which the patient is conditioned to a faradic stimulus, the response being in the form of a galvanic skin reaction Though less accurate, the much simpler and more frequently used method is to observe various normal, reflex reactions to sound — such as twitching of eyelids, face or limbs

GRAFTS

Gibson[19] has devised a way of surface refrigeration anesthesia for cutting split skin grafts by circulating ice cold water through a sterile rubber bag An electric pump mechanism is necessary The bag is strapped on the thigh until immediately before cutting the graft The irregularities of the skin surface which result from novocaine infiltration is avoided

A simple method by Clery[20] facilitates split skin grafting He places two parallel Kirschner wires subcutaneously and attaches traction stirrups to them In the flat rectangle thus formed between wires a graft is cut with a Blair knife

Fig 3A

Pickerill[21] applies Pascal's law to the fixation of a skin graft The principle is that any pressure on any part of the surface of the fluid is transmitted equally and uniformly over the whole fluid and the pressure of a fluid at rest on any surface is everywhere perpendicular to that surface He, therefore, applies pressure to grafts by using gelatin in an elastoplast box Lewis, Edwards and Phillips[22] fix the grafted part in plaster, leaving the graft itself exposed through a window. Waste or similar material is then used on the graft and a plaster lid applied The latter can be removed for changing dressings

In eliciting these responses in an infant, a great variety of instruments has been used — bells, triangles, drums, etc., the percussion instruments supposedly being most suitable Later, in an effort to gain a better idea of the range of hearing, variously pitched pipes, whistles, etc, are recommended After the age of four or five years the audiometer may be tried, but the young tend to lose interest rapidly Many investigators advocate the early use of the audiometer by means of play conditioning, *e g*, "the peep show," as suggested by Hall pike and associates

Seldom is there a completely dead cochlea If this seems to be the case, the static labyrinth should be investigated Though occurring more frequently in postnatal than prenatal deafness, complete lack of vestibular response is most uncommon.

Differential Diagnosis Since failure of speech development is the most outstanding feature of the severer forms of deafness, any condition which produces or is associated with this failure may cause confusion in the differential diagnosis

The four principal conditions which should be kept in mind in this regard are

1. Mental Retardation — in which there is a backwardness in nonauditory tests, visual inattention, emotional and intellectual lack of response, as opposed to the alertness of the deaf child
2. Speech Delay from Emotional Cause or Lack of Incentive, *i e*, the child of overindulgent parents, or at the other end of the scale, the institutionalized child
3. Motor Speech Delay, which is often seen to coincide with efforts to train away from a preferred left-handedness
4. Developmental Word Deafness — an interference with the receptor mechanism which makes speech unintelligible to the subject and, therefore impossible of reproduction Clinically and therapeutically he is an aphasic.

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REHABILITATION OF THE DEAFENED CHILD *

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One of the most important basic needs of humanity is the ability of communication with one's fellow-men In the normal chain of events, this faculty of communication depends to a great extent upon the two functions, hearing and speech, however in the problem with which we are concerned at the moment, we have learned that it is possible for the added senses of touch, sight and the sense of movement to be utilized in place of, or in addition to, hearing

For a moment, let us briefly review the history of education of the deafened In Roman times the deaf and mute were classed with the mentally incompetent and this condition persisted almost without exception until the middle of the sixteenth century Then Cardano of Padua stated that the deaf could be taught to comprehend written symbols or combinations of symbols by associating them with the object or the picture of the object they were intended to represent, that is, the association of meaningful language with experience Closely following Cardano, Pedro Ponce de Leon of Italy and Bonet of France commenced the oral education of deafened children In 1680, Dalgarno of Italy stressed the fact that deafened individuals were as mentally alert and capable of instruction as a normal person and ' there might be special addresses made to a dumb child even in his cradle " In the eighteenth century, the outstanding figures were Abbé Charles Michel de l Epee in France — who favored signs, and Heiniche in Germany — advocating speech and speech reading The influence of these men was worldwide In 1817, the first permanent public school for the deaf in the United States was

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founded in Connecticut by Gallaudet This was the forerunner of a great system of schools for the deaf, backed by the enthusiasm of Gallaudet's son, Sarah Fuller, Alexander Graham Bell, Caroline Yale and Dr Max Goldstein Thus through the work of these and many others — doctors, physicists, psychologists, sociologists and teachers, we have reached the present status, where all deafened children have the opportunity of education and communication with their fellow-men

Any proper system of education for the deafened child depends upon four main factors

1 Parental education

2 Proper diagnosis and estimation of residual hearing

3 Education by means of auditory training, language training, speech reading, and the use of the hearing aid where indicated

4 An adequate follow-up program

These factors must be considered in detail

PARENTAL EDUCATION

Many parents are loath to admit and accept the fact that their child will never hear They squander much time and money on consultations in one center after another, not realizing the harm they are doing their child by not instituting measures as early as possible Again, other parents accept their child's deafness, and then attempt to "make it up to him" by overdevotion — doing everything for him and shielding him from all contacts with normal living Thus it is that when the child commences his program of education, not only has he been deprived of communication with others, but he is a maladjusted and thoroughly spoiled child as well

The parents should be taken freely into the confidence of the otologist They should be told why the child does not hear, and what can be done to help him, stressing always the important part that they will play in that education If possible, they should be present at least at the first few lessons of the teaching program, in order that they may work in close cooperation with the educator The parents must be shown that education begins at the time the diagnosis is made or even presumed If the child is still a baby, it is held on the lap so that it can see the parent's face and talked to, kindly, lovingly, and in a normal fashion, not with mouthings and grimaces. Then the baby is held against the face and the chest, talking constantly and repetitiously so that it may perceive vibratory stimulation Gradually the child comes to associate the movement of the lips with the vibratory stimulation, and the training of the child has begun, in the mother's arms

The Ewings of Manchester have found that the voice of a deaf child of one year is not noticeable by its abnormalities There is rhythm to the voice and pitch and intensity can be varied, though the variations are fewer than normal however if left alone, about the age of 18 to 24 months, the deaf child tends to lose this range of vocal expression and the voice takes on a strained quality Gestures replace vocalization. Once the deaf child ceases to use his voice, the natural intonation never can be recovered Thus the use of the voice must be constantly encouraged, so that the sounds become automatic and eventually form the natural basis for the development of speech Articulation has to be taught speech as such can never be taught. It must become part of the child's mental and social experience and must be the result of an inner urge All this lies within the realm of parental teaching, but they in turn must be helped greatly

To facilitate the parents' education, various reading material may be recommended! the *Volta Review*, the publication of the American Association to Promote the Teaching of Speech to the Deaf, and the Volta Bureau, the *Hearing News* of the American Hearing Society, they may enroll in the John Tracy Correspondence Course or they may contact their Provincial School for the Deaf for further educational material In this way, the parents gain more insight into their child's problem.

PROPER DIAGNOSIS AND ESTIMATION OF RESIDUAL HEARING

The matter of diagnosis has been covered very adequately in a preceding paper It has been shown that practically all of the congenitally deaf cases have some island of residual hearing which can be utilized for educational purposes Likewise, many of the cases of acquired deafness have some degree of hearing reserve In a series of 460 cases investigated at the Pennsylvania School for the Deaf, residual hearing to one frequency was found to be present in 95 per cent of cases, but only 25 per cent could hear frequencies above 512 d v , however, any degree of residual hearing can be utilized in speech reading, where the child gathers his speech impressions from all his senses at the same time — visual, kinesthetic or muscular cues, and auditory

The initial stage in the estimation of residual hearing is to gain the interest of the child In most cases, there has been no preliminary parental education and the child is presented as a fretful, restless and ill-tempered being, with willfulness and self-determination the predominant emotions No attention is paid to sound, and until the child is taught to listen, little progress can be made To initiate this desire, training in a conditioned response is begun The simplest conditioned response is that of raising the hand when a loud sound is presented at the ear As a preliminary stage, this sound should stimulate both the auditory and tactile senses, such as a buzzer operating a telephone receiver Thus, even if no hearing is present, with proper training a conditioned response to a tactile stimulus is set up, but as we have shown, 95 per cent of deafened children have some residual hearing, so we proceed from there It is to be noted that throughout the training period, the child's behavior improves remarkably He becomes attentive and obedient and easier to handle in all ways When it is decided that the responses to the training device can be relied upon, a reasonably accurate audiogram may be obtained We are then ready to proceed to the actual education of the child

EDUCATION

The education of a deafened child should proceed along the lines of auditory training, speech training and language, and speech reading

First, auditory training As has been intimated previously, if there is even a suspicion that a child is deafened, his early years should be filled with loud and varied sounds Thus, he is taught awareness of sound which provides another link to the world about him This awareness of sound leads to the next step of discrimination of sound, i e, the ability to differentiate one sound from another For this purpose, the teacher may use a drum, a bell, a rattler, a whistle (preferably of low pitch) and a bicycle horn The child is shown the objects and the noise they make. He is allowed to play with them and sound them himself Then the sound is made out of sight of the child and he is required to pick out the instrument from which the sound emanated From this stage finer discriminations may be made, for example, bells of different pitch Once a child learns that sounds differ from one another, he is ready to start learning to understand speech Here again one begins with the gross discriminations between vowels — "ah' and "ee" — quite dissimilar Then one works slowly on to the consonants Following this, the child is taught to respond correctly to short sentences — 'Bring me your coat," 'Where is your hat?", etc In this way the child assigns meaning to the phrase without analyzing each part. It closely follows the normal pattern of learning As training progresses, finer discriminations are taught — the difference between "S" and 'SH," between "TH" and 'F ' He must know and understand a large vocabulary of words, and must be able to follow connected speech from conversation periods, stories, phonograph records, etc.

A very important adjunct to auditory training is the hearing aid, however, before a child is fitted with a hearing aid, his auditory training must have progressed through the stage of awareness of sound and discrimination of sound to a degree that he will receive some practical benefit from the instrument Every acoustically handicapped child who can benefit from a hearing aid should be fitted with his own instrument as soon as he is ready for it At first, the teacher covers her lips to forcibly submerge lipreading Later lipreading and hearing are trained simultaneously Only with the hearing of speech can the proper imitation of speech be possible, and the flat, unintelligible speech of the deaf be avoided

In this connection there has been an instrument produced by the Maico Co, called the Train-Ear, which consists of amplifier, phonograph turntable and radio, which is proving of great value in the re-education of the hard-of-hearing child

The second stage in education consists of speech learning and language Now that the child has become aware of sound, and his residual hearing has been trained to interpret differences in sound, and the voice as a medium of communication, he must be taught to speak properly In the child with a sufficient reserve of hearing in all frequencies, this is a matter of continuing the foregoing training, with emphasis on the hearing aid, and speech reading, however, in those cases in which there is residual hearing only for low frequencies or no residual hearing whatsoever, it becomes a more painstaking procedure, and additional methods must be utilized In the development of language, it is necessary to associate an idea with a word Once the recognition of this association is obtained, the development of language has begun To teach the word "jump," the teacher jumps To teach the word "ball," the object is shown, together with the name of the object on a card Thus, gradually, a limited vocabulary is built up

In building up a child's store of language, three major channels are substituted for the ear vision, touch and muscular movements or kinesthetic clues By visual clues, the child learns to interpret gestures and the facial activity that is the visible part of speech He is then started on the road to speech reading Through the sense of touch, the child learns of the plosive consonants (P B, etc) by feeling the gust of breath By the hand on the cheek, the nose or the larynx, he gets further information on certain sounds which give most vibration in these areas By producing the same vibration in himself, he is continually adding to his vocal knowledge. By the kinesthetic cues, the child learns of the jaw movements, tongue movements, etc., necessary for the formation of intelligible speech. Thus, whereas the normal person judges speech on how it sounds, a deaf child must base his speech on how it feels.

The third important part of education consists of speech reading, a more inclusive term than lipreading In the English language, over 50 per cent of all speech elements are either invisible or indistinguishable In the normal flow of language the invidual speech elements have a duration of only one-thirteenth of a second, therefore, visual perception of the spoken language cannot depend upon the recognition of the individual letters, but must also take into consideration muscular movements, as well as context and other clues The deafened child must observe the rhythm of sentences, the timing of syllables and the pauses between, the facial expressions and gestures Thus, he must be continually on the alert, and in many cases, tension and fatigue are produced in a short time, however, it is from this final stage in his education that the child achieves the ability of communication with others

The education of a deafened child is thus shown to be a continuous process from the time the deafness is diagnosed or presumed, through the stage of parental education, nursery school and specialized schools for the deaf until they are judged able to continue their studies with normally hearing children in public school The earlier training is begun the sooner can this objective be obtained It has been found that with preschool training 90 per cent of partially deafened children and 50 per cent of profoundly deafened children can carry on at public school, however without this preschool training, only 49 per cent of partially deaf and 1 per cent of profoundly deaf children were able to carry on public school instructions

The responsibility does not end here There must be a comprehensive follow-up program The hard of hearing child, who relies upon a hearing aid, must be rechecked regularly, and, if his hearing is deteriorating, appropriate lines of training must be instituted Some children may fall into slovenly habits of speech or their speech reading may deteriorate, necessitating a brief brush-up course, but, throughout it all, slow and painstaking as it may seem, is the constant inspiring thought that a child has been salvaged to lead a normal life and take his place in society

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Vanni[23] experimented in grafting autogenous and homogenous skin in rabbits and guinea pigs. All grafts were preserved at –3° C in the serum of the recipient animal for from two to 10 days The results were uniformly unsuccessful except for the autogenous grafts in guinea pigs, however, it is Marrangoni's[24] opinion that there is indication that refrigerated isografts stored in 10 per cent homologous serum can be successfully transplanted in the experimental animal The whole experimental problem of homografts is pointed out by Rogers [25]

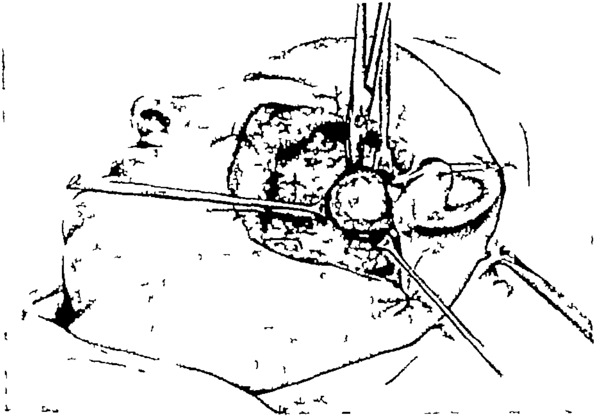

Fig 3B.

Refrigerated human autogenous skin grafts can survive and take in spite of a degree of infection which is usually assumed to be too great for normal successful fresh skin grafting Flatt[26] puts forward the hypothesis that these grafts have both intracellular and extracellular growth stimuli due to prolonged tissue hunger

The regeneration of sympathetic activity in grafted skin as evidenced by sweating is shown by McGregor [27] No new

ODONTOGENIC TUMORS AND CYSTS *†

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Odontogenic tumors and cysts are frequently encountered in the practice of otorhinolaryngology Such encounters are often fraught with confusion, for several reasons

The terminology used in discussing these structures is usually more familiar to the dentist than to the doctor of medicine The nosology, i e , the classification, of these conditions is difficult. Some would include various developmental malformations, such as the fissural cysts [1] This paper includes only those conditions purely odontogenic (Gr odous or odont, tooth plus genneo, I produce or generate) Finally, as emphasized by Willis,[2] the understanding of these conditions is based upon an understanding of the embryology concerned

GENERAL STRUCTURE OF A TOOTH

These fundamentals, the terminology, nosology and embryology, must next be considered, first starting with the general structure of a tooth (see Fig 1) As indicated, there is a crown and root portion, with enamel, dentine, cementum and pulp constituents. The embryological development of these components must next be considered, since it is their maldevelopment which accounts for the odontogenic tumors and cysts

EMBRYOLOGY

Starting about the fifth or sixth week of embryonic life, there occurs a thickening of the oral stratified squamous

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mucosa at various points along the alveolar process (see Fig 2) Observing one of these thickened areas diagrammatically, and following it along, the proliferation is seen to continue

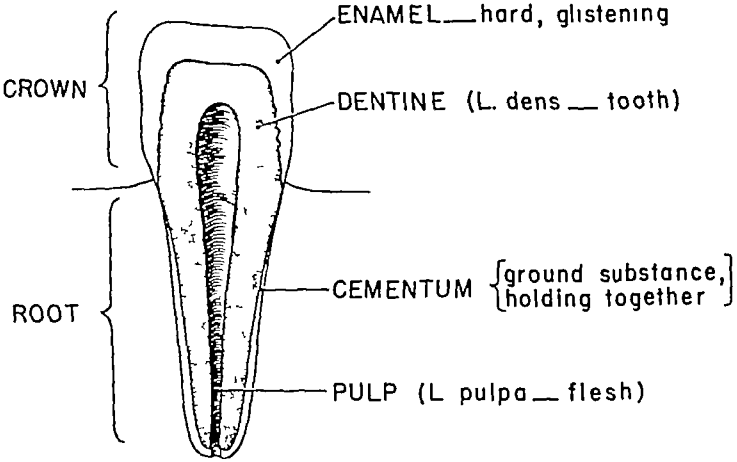
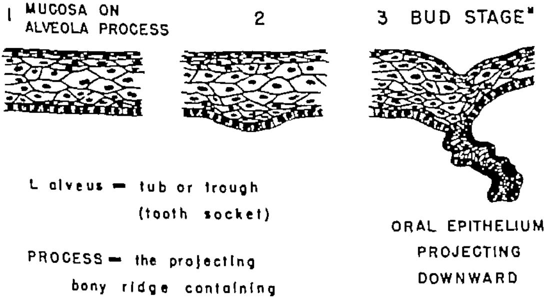

ENAMEL—hard, glistening
CROWN
DENTINE (L. dens — tooth)
CEMENTUM {ground substance, holding together}
ROOT
PULP (L pulpa — flesh)

Fig 1

until there is a downward extension of the epithelium into the submucosa The appearance of this downward projection characterizes the so-called "bud stage" (see Fig 2)

As this bud extends deeper, a knob-like thickening occurs at its deepest portion (see Fig 3) (A second thickened area at the middle of this bud will eventually form a permanent tooth) This knob-like end then begins to flatten out, so that the entire structure looks somewhat like a mushroom The stem of the mushroom, the cord of epithelium which extends from the oral surface into the submucosa, is called the dental lamina The cap of the mushroom, for which reason this is designated the "cap" stage, consists of this flattened epithelial structure which now develops a central area of different consistency This area is filled with a loose, stellate reticulum Toward the oral mucosa the stellate reticulum is bordered by what is now designated the outer enamel epithelium, its other, deeper surface is bordered by the inner enamel epithelium These three collectively are designated the enamel organ

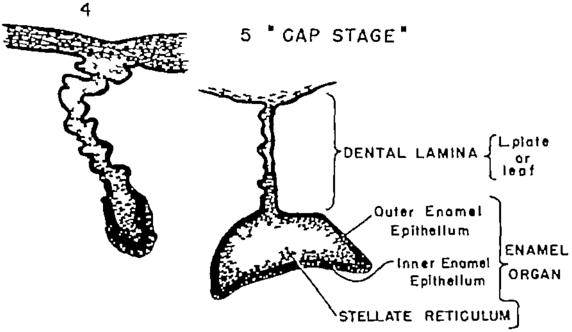

1 MUCOSA ON ALVEOLA PROCESS
2
3 BUD STAGE"
ORAL EPITHELIUM PROJECTING DOWNWARD

L alveus = tub or trough (tooth socket)

PROCESS = the projecting bony ridge containing these sockets

GINGIVA (L gum) = Connective tissue covered by mucosa

Fig 2.



L stellar = star
L rete = net

Fig 3

There now follows a condensation of mesenchymal tissue about this enamel organ (see Fig 4) This occurs especially under the inner enamel epithelium, and gradually pushes upward, forming a nipple-like projection, called the dental papilla As a result, the former "cap" now looks more like a bell, and this is, therefore, called the "bell" stage

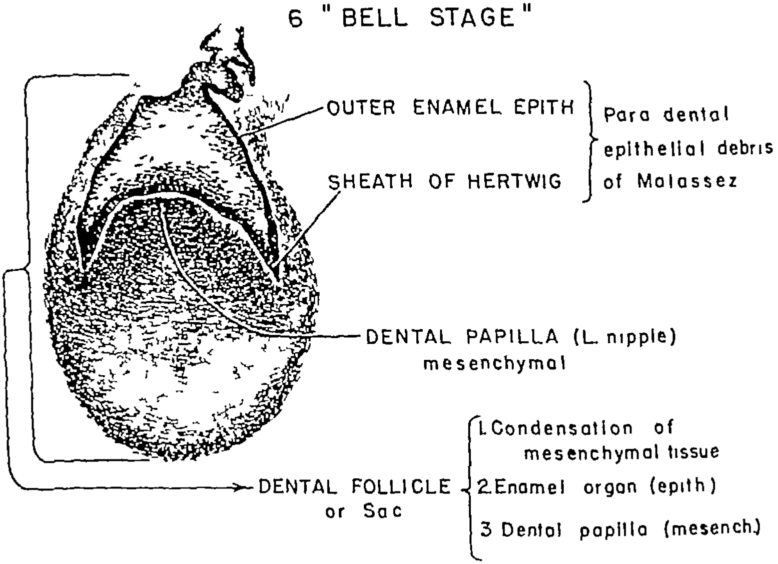

6 "BELL STAGE"
OUTER ENAMEL EPITH
SHEATH OF HERTWIG
Para dental epithelial debris of Malassez
DENTAL PAPILLA (L. nipple) mesenchymal
DENTAL FOLLICLE or Sac
1. Condensation of mesenchymal tissue
2. Enamel organ (epith)
3 Dental papilla (mesench.)

Fig 4

The juncture of outer and inner enamel epithelium forms a progressively more sharp edge In three dimensions it can be visualized as the free edge of the "bell" This is the sheath of Hertwig It and the outer enamel epithelium normally atrophy They are collectively called the Paradental Epithelial Debris of Malassez

With atrophy of the dental lamina and also with the formation of the epithelial debris, three structures are left isolated These are the condensation of mesenchymal tissue, the enamel organ, and the dental papilla They make up the primitive dental follicle or sac

The inner enamel epithelium now develops the ability to form enamel (see Fig 5) Its cells are, therefore, called ameloblasts (amelo, enamel) or adamantoblasts Opposing them, a layer of mesenchymal cells develop the ability to lay down dentine They are, therefore, called odontoblasts The formation of odontoblasts and the deposition of dentine are dependent upon the presence of an enamel organ

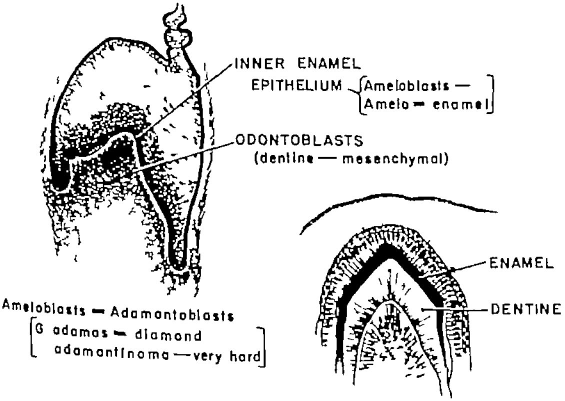


Fig 5

The ameloblasts and odontoblasts proceed to deposit enamel and dentine, the opposing layer of each becoming progressively thicker It is noteworthy that the nuclei of the ameloblasts are *basal* with regard to the deposited enamel In relation to the stellate reticulum, the nuclei are *non*basal, an important point in discussing adamantinomas later

Mesenchymal connective tissue meanwhile invades the sheath of Hertwig, pushing it outward to become debris With further condensation the connective tissue becomes the cementum (see Fig 6), and there is now a crude representation of a tooth

It can be visualized that with further differentiation, further projection of the tooth into the stellate reticulum and separation of the overlying oral tissues, the tooth erupts

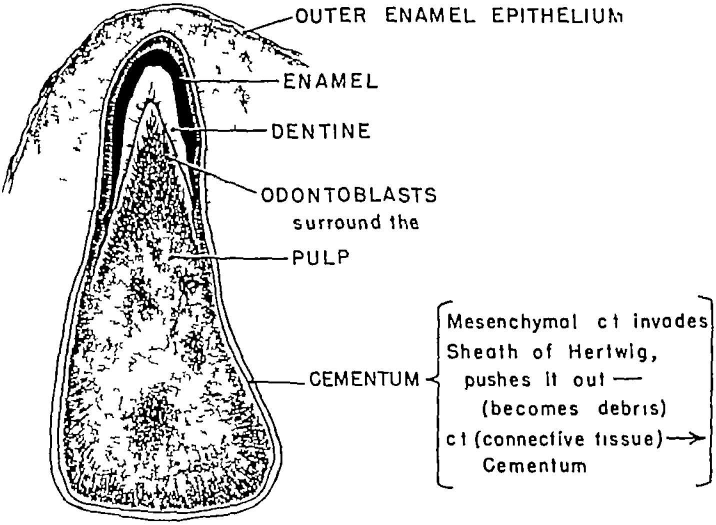

OUTER ENAMEL EPITHELIUM
ENAMEL
DENTINE
ODONTOBLASTS surround the
PULP
CEMENTUM
Mesenchymal c t invades Sheath of Hertwig, pushes it out — (becomes debris)
c t (connective tissue) → Cementum

Fig 6

The process of development diagrammatically represented in Figs 1 through 6 can be reviewed in photomicrographs made from serial sections of a fetal upper jaw This fetus had a crown-rump length of 100 mm , representing about the fourteenth week of development

The gradual thickening of oral epithelium is first observed (see Fig 7) with the "bud" stage progressing to form a dental lamina The latter progresses to the "cap" stage (see Fig 8), and the next figure (see Fig 9) shows a beginning "bell" stage

These are tissues, therefore, whose histodifferentiation is not completed until after all permanent teeth have erupted There is thus a long postnatal period in which growth disturbances may result in tumor and cyst formation

Such growth disturbances may be due to inflammatory processes or nutritional deficiences, but especially neoplasia by the developing tissues or the epithelial debris

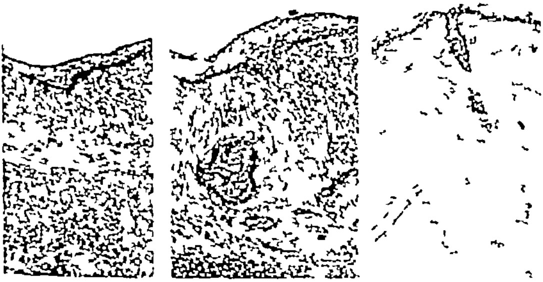


Fig. 7 Fetal jaw Oral epithelium and "bud" stage.

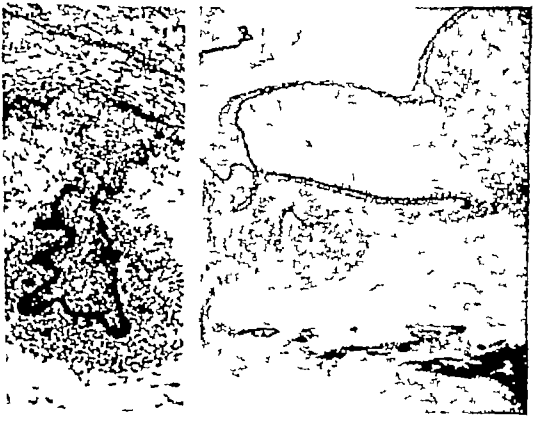


Fig. 8 Fetal jaw Dental lamina and "cap" stage

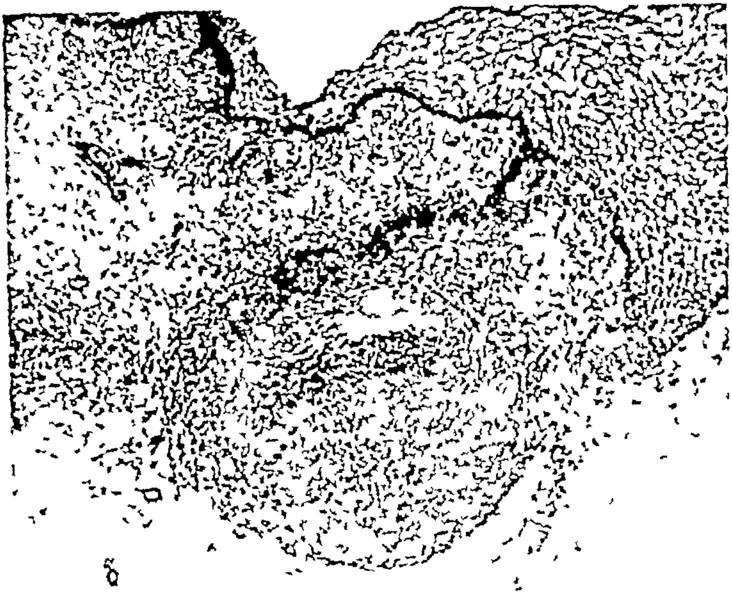


Fig 9 Fetal jaw Beginning 'bell stage

POTENTIAL MALFORMERS

Knowing the embryological and developmental components, the potential malformers can be tabulated (see Table 1) First, the epithelial debris includes that of the dental lamina, and the outer enamel epithelium and sheath of Hertwig of the enamel organ Second, the dental follicle, the potential tooth, includes the epithelial enamel organ, and the mesothelial dental papilla and cementum Components of the enamel organ are the epithelial debris of Malassez, the ameloblasts, and the stellate reticulum Components of the dental papilla include the odontoblasts and the mesenchymal tissue proper

CLASSIFICATION AND DISCUSSION OF ODONTOGENIC CYSTS AND TUMORS

Knowing the potential malformers the odontogenic cysts and tumors can be classified (see Table 2) and after each list the structure of origin, *i e*, the structure whose maldevelopment or neoplasia resulted in the pathological entity

Basically there are two types of odontogenic cysts the follicular cyst and the radicular cyst. The follicular cyst, as its name implies, arises from the dental follicle or sac, and specifically from the sac like enamel organ with its internal stellate reticulum Many of the standard ear, nose and throat textbooks lack a clear definition of follicular and dentigerous cysts As indicated in Table 2, the follicular cyst may be either simple or it may be dentigerous, *i e*, bearing a tooth Knowing the embryology, the enamel organ can be visualized early in its development, dilating and becoming a simple, follicular cyst, or doing so at a later stage, after a tooth has partially or completely formed, and, therefore, forming a *dentigerous* follicular cyst

TABLE 1.

POTENTIAL MALFORMERS

1 EPITHELIAL DEBRIS
- a Dental Lamina
- b Enamel Organ (Paradental debris of Malassez)
  - —Outer Enamel Epith.
  - —Sheath of Hertwig

2 DENTAL FOLLICLE (potential tooth)
- a Enamel Organ (Epithelial)
  - —Epith Debris
  - —Ameloblasts
  - —Stellate Reticulum
- b Dental Papilla (Mesothelial)
  - —Odontoblasts
  - —Mesenchymal tissue
- c. Cementum (Mesothelial)

Follicular cysts are usually of the dentigerous variety, frequently associated with impacted lower third molars in young people They may, however, occur in the maxilla Modifying adjectives such as central or lateral refer to the position of the cyst in relation to the contained tooth crown They may be multiple

TABLE 2

CLASSIFICATION OF ODONTOGENIC CYSTS AND TUMORS

A CYSTS	ORIGIN
1 Follicular a Simple	Enamel Organ-stellate reticulum (epith)
b Dentigerous (L dens—tooth) (genere—to bear) central lateral multiple	
2 Radicular (root) (England—dental cyst)	Paradental debris of Mallassez (Sheath of Hertwig plus outer enamel epith)

CLASSIFICATION OF ODONTOGENIC CYSTS AND TUMORS

(cont d.)

B TUMORS	ORIGIN	
1 Adamantinoma (ameloblastoma)	Enamel Organ (epith) (—no enamel found)	
2 *Odontomas*		
a *Enameloma*	*Inner Enamel epith*	
b Dentinoma	Dental papilla	mesoth
c Cementoma	C T	
d Mixed (ectod and mesod)	Varying parts of Dental Follicle	

QUALIFYING TERMS

Soft

Calcified

Complex

Compound (with teeth)

Geminated (L geminatio — a doubling, twins)

Cystic

glands are formed The graft retains the anatomical pattern of the donor skin but acquires the physiological sweating of the recipient site

According to Peer,[28] human autogenous fat grafts survive transplantation as fatty tissue and on the average lose about 45 per cent of their weight and volume one year or more following transplantation In a composite graft made up of multiple small segments of autogenous fat the loss is increased up to about 79 per cent A "cell survival theory" is postulated by this author

Fig 3C

FLAPS

The various types of grafts and flaps available for use are reviewed by Jayes[29] Hausmann and Everett,[30] in dealing with wringer injuries, apply skin grafts or flaps early in these cases in order to avoid heavy indurated scarring with subsequent deformity and loss of function

On preliminary observations of the vascular channels in tube pedicles, Braithwaite[31] concludes that dermal and sub-

The radicular cyst, as its name implies, occurs in the area of the root of a tooth, usually a diseased or devitalized tooth The epithelial debris of Malassez, particularly the sheath of Hertwig, appears prone to inflammatory disturbance and cyst formation

As indicated in Table 2, these cysts are of epithelial origin, embryologically from the parent stratified squamous oral epithelium Their lining, therefore, is stratified squamous epithelium, occasionally flattened down by the pressure of the transudate or exudate filling the cyst into a simple, pavement epithelium.

The odontogenic tumors also include two main types one is the adamantinoma or ameloblastoma, the other, the various odontomas or "tooth-tumors"

The adamantinoma arises from the enamel organ, an epithelial structure It retains the undifferentiated character of this structure in that no enamel is found in the tumor tissue. This contrasts with the enameloma As previously noted, the nuclei of the adamantoblasts, or ameloblasts, are toward the side of the stellate reticulum. This appearance of "nonbasal" nuclei is retained in the adamantinoma It is sometimes described as resembling a gland turned inside out

In one series of 379 cases of adamantinoma, 70 per cent appeared in patients in the age group of 10 to 35 years.[2] They were equally divided between the sexes Adamantinomas occur much more commonly in the mandible than in the maxilla

The local invasiveness of adamantinomas has been repeatedly emphasized, and deservedly so

The odontomas include so-called enamelomas dentinomas, cementomas and tumors of mixed tooth constituents The enamelomas are of epithelial origin the dentinoma and cementomas, mesothelial, the mixed odontoma is the most common. Often the label used merely indicates the predominant constituent. Various qualifying terms are used to describe lesser characteristics

TREATMENT

Basically, the treatment of odontogenic tumors and cysts consists of surgical excision This should include the offending tooth or teeth, in the case of dentigerous or radicular cysts Simple marsupialization of the cyst, with or without a plastic button or similtar prosthesis to keep the orifice open, has been advocated, without the removal of the cyst lining The claim is made that the cyst cavity will then granulate in Such occurrence would be a unique phenomenon in the human body Surgical diathermy to the bony surfaces of the defect helps insure complete removal of the lining membrane

Of the odontogenic tumors, excision and cure is fairly readily obtained except in the case of adamantinomas The invasiveness and locally-malignant nature of the latter cannot be overemphasized In this condition surgical excision must be radical in nature, with a wide margin The following case report illustrates this

ADAMANTINOMA REPORT OF A CASE

B P, a very lovable little four year-old boy, was first seen in the Stanford Ear, Nose and Throat Clinic in March, 1951, complaining of displacement upward of the left eye of four months' duration. Two weeks before coming to the clinic, X ray examinations had revealed an abnormality of the left maxilla Additional history is not pertinent

On examination the only positive findings included a slight proptosis of the left eye, equal palpebral fissures, but a slightly higher position of the left cornea compared to the right

Further X ray studies (see Fig 10) revealed a mass in the left antrum absence of much of the lateral and inferior walls of the antrum as well as the floor of the left orbit Tooth structures were noted in the mass

On exploration via a Caldwell Luc approach, the tumor seemed to have a capsule which could be separated from bone where present and from residual periostum where the bone had been destroyed Frozen sections determined the diagnosis of adamantinoma (see Fig 11) (The resemblance of this tissue, with its stellate reticulum and darker epithelial elements, to the developing tooth structures shown in Figs 8 and 9, is striking) An inferior meatal window was fashioned and the incision closed

Because of the notorious difficulty of complete removal of this type of tumor, the patient was then presented before the Stanford Tumor Board for advice as to the best therapeutic course The Board advised multiple biopsies of the walls of the operative defect for evidence of persistent tumor It was hoped that the left eye could be spared

Fig 10 Destruction of walls of left antrum by adamantinoma.

Fig 11 Adamantinoma.

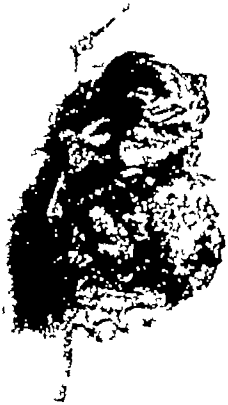


Fig 12 Orbital contents and maxilla removed en bloc.

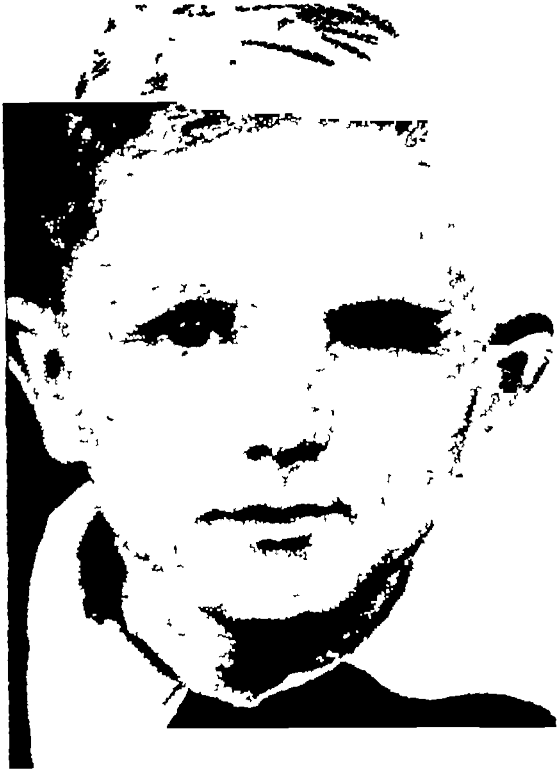


Fig 13 Patient one year postoperative

The surgical cavity was therefore re-entered and multiple biopsies taken. These showed extension of the adamantinoma to the lateral wall floor and medial wall of the antrum and involvement of the left peri orbita both anteriorly and posteriorly The Tumor Board therefore recommended radical exenteration including the left orbital contents as necessary for cure

The entire left maxilla part of the zygomatic bone the pterygoid process of the sphenoid and the entire orbital contents were then resected en bloc (see Fig 12) The incision circled the palpebral fissure extended downward along the side of the nose then along the columella separating the upper lip After removal of the specimen the eyelids were sutured together and the cheek flap and part of the surgical cavity were lined by a split thickness graft from the abdomen held in place by sponge rubber packing.

Postoperatively a dental prosthesis was fashioned to close the palatal defect. It has been modified several times with the growth of the patient. He is now one year postoperative (see Fig 13) with as yet no sign of persistent or recurrent tumor

SUMMARY AND CONCLUSIONS

A knowledge of the terminology, nosology and embryology of tooth structures is essential for the understanding of odontogenic tumors and cysts. This basic information has been reviewed, and correlated with the formation, diagnosis and treatment of such tumors and cysts The individual anlage have been tabulated Therapy has been discussed, and the need for radical surgery for cure of adamantinomas has been stressed A case report illustrates this type of therapy

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TRACHEOTOMY IN BULBAR POLIOMYELITIS

OREL FRIEDMAN, M.D.,
Glens Falls, N. Y.,
and
JOSEPH G. GILBERT, M.D.,
Brooklyn, N. Y.

Nearly all of the deaths in poliomyelitis occur in patients with bulbar involvement; therefore, any improvement in the management of this phase of the disease assumes great importance. During the past decade tracheotomy has been performed in hundreds of cases of bulbar poliomyelitis, and the literature now contains many favorable reports of its use.[1] There are other workers, however, who have had wide experience with this disease who contend that they have not seen cases requiring tracheotomy.[2,3] Even among those who advocate the operation there is a difference of opinion as to its indications and the time when the procedure should be carried out.[1]

Much of the confusion that exists is due to the fact that the pathology and pathological physiology of this disease is not too well understood. The problems involved and the literature have been reviewed quite completely by Galloway,[1b,1d,1i] Baker,[4] Cummings,[1j] Mitchell and Hill[1g] and Priest *et al.*[1c,1k]

In order to understand the clinical manifestations of the disease the following classification (Galloway and Seifert[1d]) is presented.

1. Spinal. Diaphragm and intercostal muscle paralysis.

2. Bulbar paralysis. Involvement of the swallowing mechanism and resultant accumulation of secretion, food and fluids, and vomitus in or over the airway.

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3 Bulbar spinal A combination of the above (1 and 2)

4 Other disturbances in rhythm and depth of respiration (so-called poliomyelitic encephalitis)

The use of tracheotomy in bulbar poliomyelitis is based upon the concept (Galloway[1b]) that most of the severe central effects result from anoxia and carbon dioxide accumulation due to secretional obstruction of the air passages The direct action of the virus on the central nervous system is considered less important than the effect of anoxia Tracheotomy is resorted to in order to clear the airway and relieve obstruction.

Brown[8] states that "we agree in Minneapolis as to the extreme importance of anoxia and maintenance of an adequate airway in poliomyelitis, however, we disagree in part with Dr Galloway We have seen cases showing definite and severe inflammatory involvement of the respiratory center and the circulatory center in the medulla. These cases have been studied histologically and have been reported in the literature From 1946 to 1948, we saw 318 cases of bulbar poliomyelitis with a mortality of 34 2 per cent, in spite of every effort made on our part to maintain an open airway"

The following are Brown's mortality statistics

Pure cranial nerve involvement—mortality 5 6 per cent.

Respiratory center involvement—mortality 70 per cent

Circulatory center involvement—mortality 85 per cent.

Relatively pure encephalitic symptoms—mortality 0 3 per cent.

Bulbar with involvement of diaphragm and intercostals—mortality 54 per cent

It appears from the above discussion that bulbar poliomyelitis is not a simple disease entity Many cases may be problems solely of respiratory obstruction, but others will show the more serious symptoms of medullary center involvement.

The indications for tracheotomy in poliomyelitis according to Galloway and Seifert[1d] are

1 Progressive anoxia with secretion in the upper airway

2 Unconsciousness or pronounced restlessness in a patient who does not respond to other treatment within a few minutes

3 Pronounced restlessness or stupor in a patient in a respirator, even if the paralysis is apparently of a spinal type

4 Fluid accumulation not otherwise certainly taken care of in a patient who requires a respirator

5 Bilateral paralysis or spasm of vocal cords

6 Rapidly progressive bulbar symptoms

7 Grave signs of vasomotor failure

8 Untrained or inefficient attendants, inadequate equipment or poor cooperation of the patient, with doubt that the airway will be kept constantly free of secretion

Advantages of the use of tracheotomy in the care of these patients are *1* they can be placed in a respirator and will synchronize successfully (Galloway and Seifert[1d]), *2* clearing of secretions from the lower airway is facilitated, and *3* oxygen under positive pressure which has been humidified can be delivered through the tracheotomy tube This delivery can be synchronized with the respirations and even with the respirator when necessary

The following cases represent our experience with tracheotomy in poliomyelitis at the Kingston Avenue Hospital in the years 1949 and 1950 During those two years there were 1,237 patients admitted with poliomyelitis Two hundred and three patients had bulbar or bulbar-spinal involvement and all of the deaths (89) occurred in this group The mortality rate for the patients with bulbar involvement was 43 8 per cent and the mortality rate for all the cases (1,237) was 7 2 per cent

Six tracheotomies were performed, and five of those operated upon died The case reports of the six tracheotomized patients are presented on next page

CASE REPORTS

Case 1 A 16-year-old white male was admitted on Sept. 3 1949 with a history of vomiting headache and stiffness of the neck of 12 hours duration. Examination revealed a slight nuchal rigidity and bilateral hamstring spasm Spinal tap revealed 495 cells He developed a rapidly ascending paralytic involvement, so that on Sept. 4 there was paralysis of both lower extremities and the intercostal muscles. A slight nasal twang was noted. On Sept. 5 he began to vomit continuously and became lethargic Frequent suctioning was required A Levine tube was passed and he was placed in an oxygen tent, and a tracheotomy was then performed At the completion of the operation the color of the patient was described as 'poor" and in spite of oxygen suction and stimulants he never improved He expired 15 minutes after the completion of the tracheotomy

Autopsy Findings There is a tracheotomy wound in the midline of the neck extending to between the second and third cartilages The tracheal mucosa about the wound is reddened Within the tracheal and bronchial passages there is a moderate amount of gastric contents The right lung weighs 290 gm the left 250 gm. Both lungs are voluminous hypercrepitant and emphysematous They are pink in color and show a few patches of atelectasis bilaterally at the hilum. The diagnosis was emphysema and atelectasis of the lungs.

Case 2 A five-year-old white male was admitted on Sept. 12 1949 with a two-day history of sore throat, fever and vomiting. On admission his temperature was 102° F He had a rigid neck, bilateral hamstring spasm occasional upper extremity tremulousness and a suggestion of a nasal twang Spinal fluid showed 87 cells On the day after admission he developed a large amount of mucus in the throat, respiratory distress and tremor There was reddening of the pharynx with pooling of mucus The uvula deviated to the left and the right palatine arch was widened Direct laryngoscopy revealed abductor weakness of the left vocal cord A tracheotomy was performed At the completion of the operation the patient's condition was good His color was good and there was no dyspnea. Within five hours however there was rapid deterioration of his condition with the development of quadriplegia intercostal and diaphragmatic paralysis. He was placed in a respirator and oxygen tent. There was no difficulty in keeping the tracheotomy tube free from secretions. Despite this therapy he went into a coma, had a convulsion and expired about eight hours after the tracheotomy

Autopsy Findings Right lung weighs 220 gm. and the left weighs 14[illegible] gm. Both lungs show hemorrhagic areas scattered throughout (left more than the right) There is a small amount of aspirated gastric contents in the lower trachea and bronchi

Case 3 A 19 year-old white male was admitted on Sept. 17 1949 with an onset three days previously of sore throat headache and nausea. Vomiting malaise and difficulty in swallowing commenced the next day At the time of admission he was vomiting and his temperature was 102° F There was a nasal twang and slight deviation of the tongue and uvula to the right. There was no stiffness of the neck. Spinal tap was done and the cell count revealed 95 cells Later on the day of admission he developed difficulty in breathing and became very apprehensive His face was markedly suffused and dusky There was pooling of mucus in his throat. Tracheotomy was immediately performed His color was good at the completion of the procedure About two hours later however he developed irregular respirations (like Cheyne-Stokes) and again became restless and apprehensive His temperature was 102 6° F blood pressure 130/90 and the pulse was of good quality but rapid The tracheotomy tube was not obstructed and nothing was obtained on suctioning His skin became cold and mottled Despite oxygen and supportive treatment, he expired about 12 hours after the operation No autopsy was obtained

Case 4 An eight year old white male was admitted on Sept 24 1949, with a four-day history of nausea vomiting and fever For two days he had had back and neck spasm He had a nasal twang for one day Examination revealed a rigid neck a nasal twang and deviation of the uvula to the right. On the following day his condition was worse He showed weak intercostal function and the respirations were rapid and shallow but regular in rhythm There was left deltoid weakness and a right facial paralysis He developed difficulty in swallowing and clearing the hypopharynx of the rapidly accumulating secretions He was oriented but lethargic A direct laryngoscopy was performed and an accumulation of secretions in the epiglottic region was noted There was a paralysis of the right vocal cord An airway was introduced, and a tracheotomy was performed over it The postoperative course was smooth There was no further respiratory difficulty Blocking of the tracheotomy tube was started one week after the operation, and he was decannulated on the eleventh postoperative day On Oct 24, 1949 (one month after admission) he was discharged to an orthopedic hospital for further treatment of a left deltoid weakness Except for this, however, he was well and the pharyngeal and palatal muscles were functioning normally

Case 5 A nine year old white male was admitted on Sept 30 1949, with a history that two days previously he had been beaten by three boys The following day he was dizzy and nauseated On the day of admission he was incoherent he had vomited and had been unable to sleep His temperature was 104 2° F and he had nuchal rigidity, a right facial paralysis palatine paralysis with inability to swallow deviation of the tongue to the left, weakness of the right leg and absent abdominal reflexes There was pooling of secretions in the pharynx, he was unable to speak and was periodically cyanotic No spinal tap was performed A direct laryngoscopy was done and excessive secretions were found in the hypopharynx. The glottic chink was half open with no abduction and sluggish adduction of the vocal cords An airway was inserted and tracheotomy was performed He was placed in an oxygen tent. Two hours postoperatively he seemed more responsive and his general condition was somewhat improved Eight hours after the tracheotomy he became worse, he was cyanotic and the respirations were irregular and shallow He did not respond to commands His face was ashen, the lips and fingers cyanotic and a mottled erythema was seen over the trunk His blood pressure was 120/80 and his pulse was 130 He expired 13 hours after the tracheotomy No autopsy was obtained

Case 6 An eight year old white male was admitted on Aug 14, 1950 with a one-day history of headache nausea and vomiting A nasal twang was noted on the day of admission He had a temperature of 101 2° F good color and normal respirations The palatal and pharyngeal muscles were immobile and there was regurgitation through the nose Spinal tap showed 222 cells The following day the patient had inspiratory stridor and difficulty keeping the pharynx clear of secretion He appeared toxic and had anxious facies Direct laryngoscopy revealed secretions in the hypopharynx There was a good airway and no vocal cord paralysis It dermal plexuses appear to be the most prominent features of the vascular system of the tube, that the venous elements of the subdermal plexus appear enlarged and that venous inadequacy appears to be the primary mechanism involved in cyanosis of the pedicle. Hynes[32] derives practical application from the *fact that the blood vessels in a tube are denervated of* sympathetic fibres, completely or partially, and, therefore, are dilated and do not respond to changes of temperature or trauma For a white flap where pressure of entering blood is insufficient to drive it through to all parts, gravity can be used as a supplement and the distal end of the flap can be lowered till blue, then alternately raised and lowered For a blue flap where pressure of entering blood drives it to all parts but is insufficient for return the routine is reversed

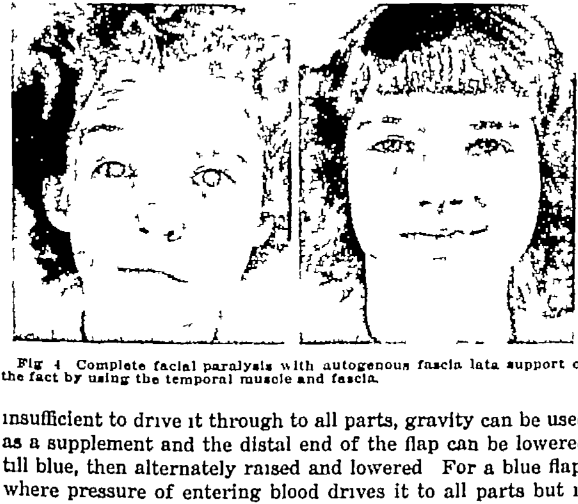

Fig 4 Complete facial paralysis with autogenous fascia lata support of the fact by using the temporal muscle and fascia.

Olander[33] has described a nicotinic acid-epinephrine test that determines the source of blood supply to a skin flap Nicotinic acid causes marked generalized vasodilatation with skin flushing Multiple injections of 1 30,000 epinephrine cause blanching which, when it crosses the scar about a flap, shows the presence of a collateral or dependent circulation was felt that the secretions were causing a spasm of the glottis An air way was inserted and a tracheotomy was performed over it. He withstood the procedure well and his breathing was made more comfortable His pulse became stronger and he was able to doze off for a while About five hours after the completion of the tracheotomy however he became cyanotic his pulse became rapid and thready and his temperature began to rise His airway was clear Despite oxygen and supportive therapy his temperature went up to 108° F and he expired about seven hours after the operation

Comment The patient in Case 1 was operated upon in the terminal stage of his illness when there was spinal, cranial nerve, circulatory center and encephalitic involvement Autopsy revealed evidence of aspiration of gastric contents Certainly if tracheotomy is expected to help, it should be done before the patient is moribund

The other four patients who died were operated upon early while their general condition was good In all of them there was pooling of secretions requiring frequent suctioning to prevent obstruction of the airway and hypoxia There was cranial nerve involvement, as indicated by palatal paralysis, and in some of the cases pharyngeal paralysis was recorded Two of these patients had vocal cord paralysis, one unilaterally and the other bilaterally In one patient the stridor appeared to be due to spasm of the vocal cords No technical difficulty was encountered during the operations as they were all done in patients who were not in a respirator Some of the tracheotomies were done over an airway In none of these six patients did pneumothorax or mediastinal emphysema develop postoperatively The immediate relief of dyspnea cyanosis and restlessness after the operation proved that the obstruction had been overcome No difficulty was encountered in keeping the tracheotomy tube clear of secretions and in none of these patients were there excessive secretions in the trachea and bronchi after the operation

There was evidence of cardiovascular center involvement in four patients (Cases 1, 2 3 and 6) and respiratory center involvement in one (Case 5) In Case 4 the disease was limited to spinal and cranial nerve involvement and we believe that tracheotomy saved this patient's life Chart I is a summary of the findings in the six tracheotomized patients

Brown and Baker[6] state that "the involvement of the respiratory regulating center generally develops somewhat later in the illness than do the cranial nerve palsies" It would seem to us, therefore, that in the patients upon whom we operated early we provided a good airway and oxygenation, but we did not alter the effect of the virus on the medullary centers, as suggested above, and this ultimately led to the death of the patient On the other hand, had a tracheotomy not been performed, these patients would have probably died from the effect of anoxia and carbon dioxide accumulation before the full effect of the virus could be brought to play upon the medullary centers

Only one of these patients was placed in a respirator postoperatively Although oxygen was given to these patients after the operation, none was administered by positive pres-

CHART I

SUMMARY OF TRACHEOTOMIZED CASES

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Lived or Died	Died	Died	Died	Lived	Died	Died
Day of Disease Before Operation	3rd	3rd	4th	5th	4th	3rd
Bulbar (B) or Bulbar-spinal (BS)	BS	BS	B	BS	B	B
Palatal Paralysis	Yes	Yes	Yes	Yes	Yes	Yes
Pharyngeal Paralysis	?	?	?	Yes	Yes	Yes
Vocal Cord (abductor) Paralysis U-unilateral B-bilateral	*	U	*	U	B	None
Spasm of Vocal Cords	*	No	*	No	No	Yes
Pooling of Secretions	4+	4+	3+	4+	3+	4+
Condition at Time of Tracheotomy	Poor	Good	Good	Good	Fair	Good
Condition Immediately After Tracheotomy	Expired	Good	Good	Good	Fair	Good
Time of Onset of Deterioration Post-operatively (hours)	Immediately	5	2	----	8	5
Expired Post-operatively (hours)	¼	8	12	----	13	7
Type of Death CV- Cardiovascular failure R- Respiratory failure	CV	CV	CV	----	R	CV

*--Not Examined

sure through the tracheotomy tube On the basis of our present experience we can only speculate as to whether our results would have been better if the respirator and humidified oxygent under positive pressure had been used in the patients who died

The survival rate of 16 6 per cent (one out of six) for the patients with bulbar poliomyelitis undergoing tracheotomy was lower than that for all the patients in this series with bulbar involvement, which was 57.2 per cent (114 out of 203) These figures merely indicate that the more desperately ill patients are operated upon, and a fair percentage of those who survive owe their lives to the operation It would be entirely wrong to attribute the increased mortality rate to the tracheotomy itself Chart II indicates that the experience of other workers coincides with ours

CHART II

MORTALITY RATE

	Bulbar Cases	Deaths	Number of Tracheotomies	Deaths
Miller and Buck[1h]	388	101	198	77
Mitchell and Hill[1g]	39	4	10	4
Strobel and Canfield[1f]	17	6	10	5
Priest *et al*[1k]	169	65	56	31
Friedman and Gilbert	203	89	6	5

SUMMARY

1 Tracheotomy may be a life-saving procedure in bulbar poliomyelitis

2 On the basis of our limited experience we believe that the operation is indicated in the presence of

a Bilateral vocal cord paralysis

b Secretion obstructing the airway especially when associated with unilateral vocal cord paralysis or spasm of the larynx

3 It is preferable to perform the operation before there is evidence of medullary center involvement.

4 In spite of an early and well-functioning tracheotomy, involvement of the medullary centers, with respiratory and circulatory failure, does follow

5 This report covers our experience with six patients with bulbar poliomyelitis who underwent tracheotomy, five of whom died We believe that the operation saved the life of the patient who survived

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6 Brown and Baker Quoted from Priest, *et al* 1c

17 Pine Street

1404 President Street

LARYNGOSCOPE MODIFIED FOR OXYGEN INSUFFLATION[†]

MERRILL W MICHELS, M.D ,
Oakland, Calif

The modification of the standard Jackson and Holinger laryngoscope with a channeled tube[*] so that oxygen can be insufflated during laryngoscopic procedures has provided a much more useful instrument.

The coincidental use of oxygen with sodium pentothal and curare in performing laryngeal operations prevents hypoxia and allows for greater latitude of procedure. Good preliminary anesthesia is essential, morphine and either atropine or scopalamine should be administered prior to pentothal to check the manifestations of parasympathetic stimulation such as laryngeal spasm or cough. Sodium pentothal produces unconsciousness but does not inhibit reflex muscular activity, this reflex is depressed by preliminary medication The reflex activity of the larynx can be satisfactorily blocked by the use of a topical anesthetic as pontocaine 2 per cent Since the margin between production of relaxation and respiratory paralysis is narrow with curare, artificial respiration with oxygen is often necessary

The direct channeling of oxygen to the glottis while doing laryngoscopic procedures has obviated many of the disagreeable features of pentothal and curare.

It has been my practice to introduce routinely an endotracheal tube on completion of the laryngoscopic work and to

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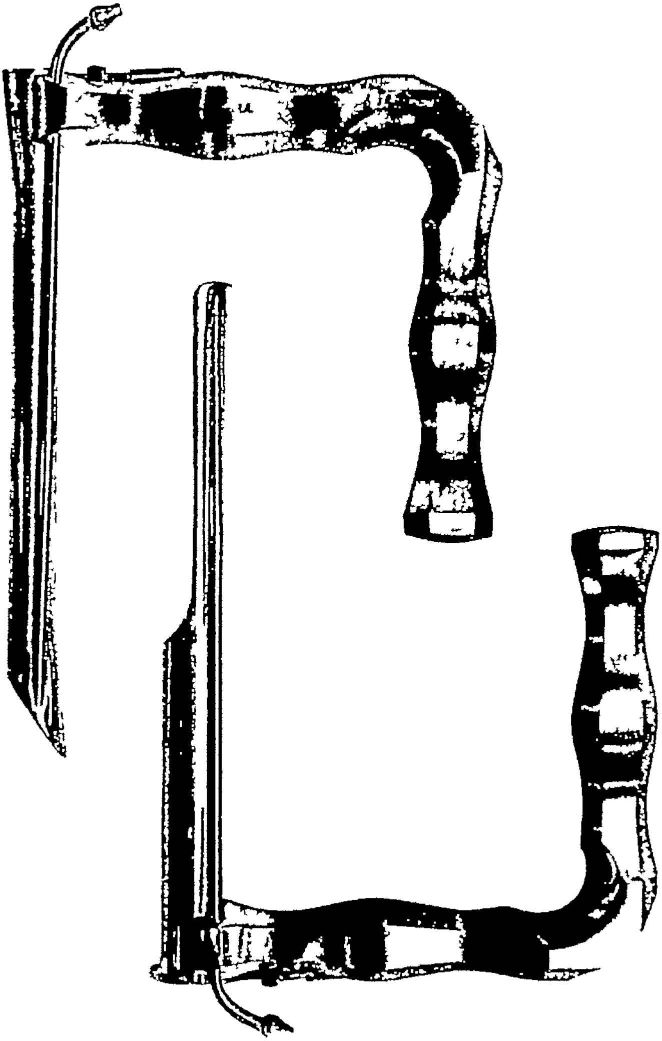
These instruments were specially made by George P Pilling and Son Co Philadelphia, Pa.

[†] From the Department of Otolaryngology Permanente Hospitals.

Editor's Note This ms received in Laryngoscope Office and accepted for publication, March 20 195

leave it *in situ* until the patient has well reacted The help of a competent anesthetist is a requisite



AMERICAN MEDICAL WRITERS ASSOCIATION

Dr Walter C Alvarez, of Chicago, nationally known medical editor, author and teacher, has been honored as recipient of the first Honor Award to be given by the American Medical Writer's Association The award, consisting of a gold medal and certificate, was presented to Dr Alvarez at the dinner on the occasion of the ninth annual meeting of the association at the Jefferson Hotel, St Louis, Oct 1 Dr Alvarez is Editor-in-Chief of *Modern Medicine* Professional Lecturer at the University of Illinois College of Medicine

The Distinguished Service Award of the association was given to Dr Harold Swanberg, of Quincy, Ill

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MISSISSIPPI VALLEY MEDICAL SOCIETY

Dr Philip S Hench, of Rochester, Minn, internationally known internist and research worker, has been honored by the Mississippi Valley Medical Society as its Honor Award recipient for 1952 The award, consisting of a gold medal and a certificate was presented Dr Hench at the banquet on the occasion of the seventeenth annual meeting of the society at the Jefferson Hotel St. Louis, Oct. 2 Dr Hench is Professor of Medicine, Mayo Foundation, University of Minnesota, and a 1950 Nobel Laureate in Physiology and Medicine

Dr Willard O Thompson of Chicago Ill was given the Distinguished Service Award of the society

In Memoriam

MOSES DAVID LEDERMAN, M D ,

1868-1952

With the passing of Dr M D Lederman, of New York City, on Sept 7, 1952, the medical profession and the community lost a pioneer physician, a gifted author and editor and a great personality

Dr Lederman received his M D degree from the medical department of the University of Pennsylvania in 1889, and his postgraduate study was continued in the clinics of London, Rome, Vienna, Berlin and Egypt Shortly after completing his studies he became associated with Seiler (Seiler's Cartilage and Seiler's Tablets) and within two years he was entrusted with the major responsibilities both at Dr Seiler's office and at several of the most important otolaryngological clinics in New York City

His professional development was rapid Very early in his career he revealed unusual surgical skill and by the turn of this century he was recognized as an outstanding leader in his specialty About this time he was appointed Associate Professor of Otolaryngology at the Poly-Clinic Hospital and at the same time served as Chief of Clinics at Manhattan Eye and Ear Infirmary and at Mount Sinai Hospital

In 1895, he became a charter member of the American Laryngological, Rhinological and Otological Society and he was the first otolaryngologist to be invited to the editorial staff of THE LARYNGOSCOPE when it was established in 1896, in which capacity he served for 56 years He was an ardent supporter of this journal throughout his professional life, and his long association with it was a source of great pride to him and of great service to the journal

In 1908, Dr Lederman was chosen Senior Otolaryngologist to Lebanon Hospital and served on its medical board as member, officer and finally as consultant until his death He derived great satisfaction from his association with this hospital for these many years, and he counted every member of the medical staff and Board of Managers as his friends

In an era antedating specific drugs and antibiotics he developed techniques and methods in the management of suppurative ear conditions and described these methods in numerous publications He was in constant correspondence with specialists all over the country

Dr Lederman belonged to a generation of leaders, trail blazers and teachers who made worthwhile contributions to medical history and we are indebted to him for his share in these contributions

It has been said that every practicing physician renders psychiatric services by his manner and personality, and Dr Lederman's personality was most engaging and genial

Tall, distinguished looking, with resonant voice and a ready smile, he was popular with all he met his love for his fellow men and his cheerful disposition were very obvious, and people were readily attracted to him He had a word of cheer for everyone, and on all occasions his warm heartedness was evident in his speech and gesture. He never grew old in spirit and he was especially popular with the young

On his visits to the hospital in recent years he was the center of attraction He was an excellent raconteur and you could see him surrounded by a group of eager listeners, both young and old recounting most vividly some incident which he said occurred in his long and active career These events were inexhaustible and were rarely repeated in the same way except for the twinkle in his eye and the dimple in his left cheek These stories were frequently punctuated with a chorus of laughter His subtle sense of humor was used effectively to dissipate tension or to create an atmosphere of hopefulness with his patients

At the operating table he was a skillful technician and an excellent teacher To the bedside he brought comfort and cheer, to the younger physicians he gave encouragement and inspiration and to his colleagues, warmth friendship and understanding

We shall remember him as a warm hearted friend and as a kind, considerate fellow-worker His absence will be keenly felt

D G

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION

October 1, 1952

Audicon Models 400 and 415

Manufacturer National Earphone Co , Inc , 20-22 Shipman St., Newark 2, N J

Auditone Model 11

Manufacturer Audio Co of America, 5305 N Sixth St., Phoenix, Ariz

Audivox Model Super 67

Manufacturer Audivox, Inc., 259 W 14th St., New York 11, N Y

Aurex Models L and M

Manufacturer Aurex Corp , 1117 N Franklin St., Chicago, Ill

Beltone Symphonette, Beltone Mono-Pac Model M

Manufacturer Beltone Hearing Aid Co , 1450 W 19th St , Chicago, Ill

Cleartone Model 500, Model 700, Cleartone Regency Model

Manufacturer American Sound Products Inc , 2454 S Michigan Ave , Chicago 16, Ill

Dahlberg Model D-1, Dahlberg Junior Model D-2

Manufacturer The Dahlberg Co , 2730 W Lake St., Chicago 16, Ill

Dysonic Model 1

Manufacturer Dynamic Hearing Aids, 43 Exchange Pl , New York 5, N Y

Electroear Model C

Manufacturer American Earphone Co , Inc , 10 East 43rd St., New York 17, N Y

Gem Hearing Aid Model V-35, Gem Model V-60

Manufacturer Gem Ear Phone Co , Inc , 50 W 29th St , New York 1, N Y

Goldentone Models 25, 69 and 97

Manufacturer Johnston Hearing Aid Mfg Co 708 W 40th St , Minneapolis 8, Minn

Distributor Goldentone Corp 708 W 40th St., Minneapolis 8 Minn

A pattern or stemless flap as illustrated by Blocker and Mithoefer[34] is a type of aseptic direct flap for certain extremity defects when it is possible for the recipient area to serve in closing the raw surface of the flap bed until the pedicle is ready to be severed

Radical surgery for bulky cancer of the head and neck will often produce through-and-through defects into the mouth or pharynx which Catlin[35] feels can most satisfactorily and safely be closed with tubed pedicle transplants Kazanjian[36] describes local advancement flaps, rectangular neck flaps, bipedicled neck flaps, tubed flaps, and swinging rotation flaps of Esser in the repair of facial deformities

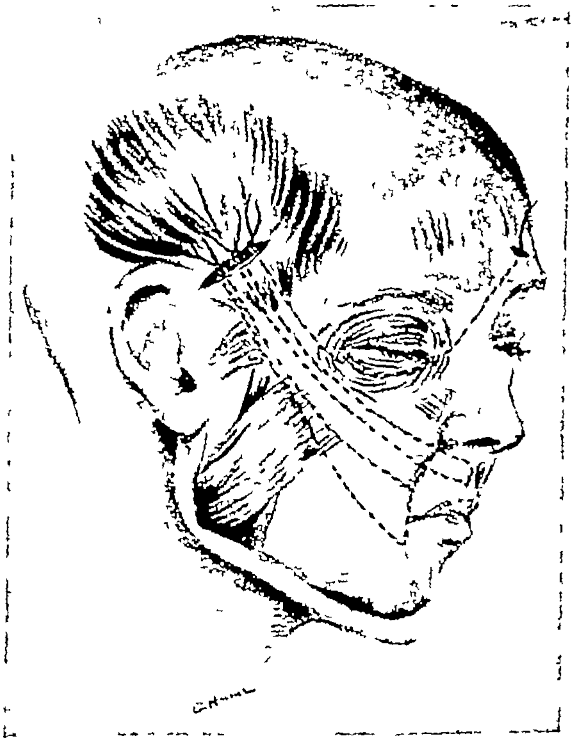

Fig 5.

Maico UE-Atomeer, Maico Quiet Ear Models G and H, Maico Model J

Manufacturer Maico Co., Inc., 21 North Third St. Minneapolis 1 Minn

Mears (Crystal and Magnetic) Aurophone Model 200, 1947—Mears Aurophone Model 98.

Manufacturer Mears Radio Hearing Device Corp. 1 W 34th St., New York, N Y

Micronic Model 303, Micronic Model "Mercury", Micronic Star Model

Manufacturer Micronic Co 727 Atlantic Ave Boston 11 Mass

Microtone T5 Audiomatic, Microtone Classic Model T9, Microtone Model T10, Microtone Model T612, Microtone Model 45

Manufacturer Microtone Co Ford Parkway on the Mississippi St. Paul, Minn. Minneapolis 9 Minn.

National Cub Model C, National Cub Model D (Duplex), National Standard Model T, National Star Model S, National Ultrathin Model 504, National Vanity Model 506

Manufacturer National Hearing Aid Laboratories 815 S. Hill St. Los Angeles 14 Calif.

Otarion Model E-4, Otarion Models F-1, F-2 and F-3, Otarion Model G-2, Otarion Model G-3

Manufacturer Otarion Hearing Aids 159 N Dearborn St. Chicago Ill

Paravox Model D, "Top-Twin-Tone", Model J (Tiny-Mite), Paravox Model XTS (Xtra-Thin), Paravox Model Y (YM, YC and YC 7) (Veri-Small)

Manufacturer Paravox, Inc. 2056 E. 4th St. Cleveland Ohio

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Manufacturer W E Johnson Mfg Co, 708 W 40th St, Minneapolis Minn

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Manufacturer Solo Pak Electronics Corp, Linden St., Reading, Mass

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Manufacturer Telex, Inc, Telex Park, Minneapolis 1, Minn

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Manufacturer Vacolite Co 3003 N Henderson St. Dallas 6 Tex.

Western Electric Models 65 and 66
Manufacturer Audivox, Inc., successor to Western Electric Hearing Aid Division, 259 W 14th St. New York 11 N Y

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EYELIDS AND ORBIT

The distortion of orbital contour secondary to maxillary and zygomatic fractures, congenital malformations, osteomyelitis, radiation necrosis or destructive surgery may result in ptosis of the eyeball with diplopia as well as facial asymmetry Converse and Smith[37] restore the orbital floor by inserting autogenous or homogenous bone grafts through an external incision in the lower lid but state that where there is a large defect of the maxilla an intraoral incision may be used. Their objection to foreign substances is the frequency of extrusion Preserved cartilage is absorbed and autogenous cartilage curls DeVoe[38] has found that the repair of orbital deformities with glass wool has not been satisfactory In nine cases out of 19 the material was extruded

McDowell[39] has devised a new orbital implant which is anchored to the back of the socket. It consists of a semicircular gold band with a straight gold band bridged vertically across the two ends, the straight band is hinged to one end of the curved piece and snaps into the other end The straight portion has a square hole in its midsection for reception of a similar square peg which is fused on to the back of the prosthetic eye A semicircular skin tunnel is prepared in the orbital tissues for this implant. The advantages of such a prosthesis are twofold first, better movement is possible, and second, the top of the prosthesis can be built out, bringing the upper lid forward and eliminating the common 'sunken" deformity in this area. It does not put weight and pressure on the lower lid causing it to sag down and forward

A permanent camouflage of corneal scars using insoluble tattoo pigments has been achieved in 75 instances without complication by Pickrell *et al*[40] Visual acuity has even been improved with tattooing by reducing the area of an abnormal cornea through which dipersing pencils of light pass

At times during the removal of an extensive epithelioma involving a portion of the eyelids as well as adjacent structures, Figi[41] has found it advantageous to draw the palpebral

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REVIEW OF AVAILABLE LITERATURE ON THE PHARYNX AND PHARYNGEAL SURGERY FOR 1951*

FRANCIS E LEJEUNE, M D , and MILES LEWIS, M D ,
New Orleans, La.

ANOMALIES

Schmidt[1] presents a case of bilaterally elongated styloid processes in a professional singer The patient had difficulty in reaching and holding high notes and had some pain and discomfort in the throat. The diagnosis was made by palpation and confirmed by Roentgenography At operation the stylohyoid ligament was found to be ossified, exposure through the tonsillar fossa was obtained, and one inch of the elongated process was removed on each side Following this procedure the patient's symptoms cleared up

Schmidt also describes the embryologic development of the styloid process, which is intimately connected with the hyoid bone. The average styloid process is 2 5 cm long, longer ones are encountered in only 4 per cent of cases Various diagnostic points are presented, but it is the opinion of the reviewers that intraoral palpation is unexcelled

Longacre[2] presents a case of an infant three months old with congenital atresia of the fauces which he believed to be due to failure of rupture of the buccopharyngeal membrane. The defect was corrected surgically, and the child was in excellent health at the time of this report.

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Numerous variations in surgical technique for the correction of atresia of the posterior nares have been tried, most involve some destruction of the soft parts and removal of part of the nasal septum Beinfield[3] describes a comparatively simple technique which proved effective and nondestructive in one case of unilateral bony atresia of the posterior nares An incision is made along the floor of the nose and is extended up onto the septum just inside the cut nares The mucoperiosteum is elevated from the floor of the nose and septum and from the anterior surface of the bony atresia The bone closing the posterior nares is then removed with a small mastoid gouge The mucoperiosteum is replaced and a stellate incision made through the nasal and nasopharyngeal mucosa over the posterior choana A large rubber tube is passed through this opening and maintained in place five days Beinfield admits that it is too early to evaluate the final result, but he points out that the principle "is sound and should work out well"

A rather complete discussion of atresia of the posterior nares is included

DISEASES

Thibaudeau[4] reports an interesting case of atlantoaxial subluxation which was due not to trauma but to an acute pharyngeal infection complicated by catarrhal otitis in a child nine years old Penicillin therapy cured the torticollis and a Roentgenogram taken seven days after the first film showed normal bony structure and articulations

Segundo and associates[5] encountered a syndrome characterized by paralysis of the last four cranial nerves described in 1864 by Hughlings Jackson The most frequent causes of such symptoms are malignancies of the nasopharynx or base of the skull, trauma, particularly military injuries, and occasionally inflammatory infections involving the base of the skull or lateral adenopharyngeal wall A case is reported in which the last four cranial nerves were paralyzed, and examination of the patient finally established existence of a lateral pharyngeal abscess with extension to the base of the skull

Administration of penicillin and streptomycin controlled the infectious process and resulted in gradual disappearance of the paralysis

Barton[6] believes that subacute thyroiditis as a cause of sore throat is often overlooked by the practicing physician He has noted that the sensation of a lump in the throat is most often due to thyroid disease, although this has not been our experience A brief discussion of hoarseness in thyroid disease is given

Cheney[7] has made a study on the prevention and treatment of colds over a period of 20 years in 2,667 University of California students For convenience the students were divided into three groups of estimated natural resistance to infection Few conclusions could be drawn from the study Some patients with severely deviated septums had no colds, whereas others with no mechanical defects had frequent colds The best results in decreasing the number of colds were obtained by combined medical, allergic, and ear nose and throat therapy

In a discussion of the structure and function of the upper respiratory tract and pharynx, Cawthorne[8] shows that the lymphoid elements of Waldeyer's ring serve to filter and sample bacteria and viruses passing over them and that some antibodies may be elaborated in this tissue in defense against infection The pathogenesis of the common cold is presented The possible relationship between the development of bulbar poliomyelitis and recent operations on the tonsils and adenoids is still not known, but it is believed that until more is known of a possible relationship, tonsillectomy and adenoidectomy should not be done when there is a high incidence of poliomyelitis in the community

Brunner,[9] in reporting a most interesting case of eosinophilic granuloma of the mouth, pharynx and nasal passages expresses the opinion that the lymphatic tissue of the upper respiratory and digestive tracts does not become frequently involved in chronic systemic disease of the hematopoietic apparatus The opinion is correct if only gross changes of the lymphatic tissue, such as enlargements or ulcerations, are considered, however, microscopic changes are frequently encountered Brunner briefly reviews the findings in Hodgkin's disease in the respiratory and digestive tracts and then reports in accurate detail a 12-year observation on a most interesting case in which the symptoms were suggestive but not diagnostic of Hodgkin's disease The persistent enlargement of various groups of lymph nodes in the mouth, palate, pharynx and nose presented baffling problems Tissue eosinophilia was present and the eosinophile count in the blood was 67 25 per cent A thorough discussion of Hodgkin's disease, incorporated in this article, adds to its interest Because the case would not conform to the pattern of Hodgkin's, a diagnosis of eosinophilic granuloma was finally made

Asherson[10] discusses the three different syndromes associated with malignancy of the epipharynx and adjacent areas These are distinguished by the site of origin of the tumor The first is Trotter's syndrome, which is stated to be an endothelioma of the lateral wall of the nasopharynx beginning submucosally in the sinus of Morgagni It is manifested by deafness followed by pain and anesthesia in the third division of the Vth nerve Later, asymmetry of the palate due to infiltration of the palatine muscle occurs The second is the pterygopalatine fossa syndrome, which is caused by either a metastatic tumor in the pterygopalatine fossa or direct extension into the pterygopalatine fossa from a tumor of the posterior part of the lateral wall of the nose It is distinguished by primary pain over the second division of the Vth nerve, fullness of the temporal fossa and later by third division pain, deafness and paralysis of the palate Finally, the Jacod syndrome of the carrefour petrosphenoidale, which produces the symptoms of both Trotter's and pterygopalatine fossa syndromes, is caused by primary malignancy of the middle cranial fossa involving the second and third divisions of the Vth nerve at the foramen rotundum and ovale The anatomy and symptomatology of these syndromes are described in great detail and illustrative case reports are cited

Titche[11] reports a case of chronic peripharyngeal tuberculous abscess in a man 32 years old which was secondary to tuberculous adenitis of the anterior cervical lymph nodes. It was successfully treated by aspiration and local and systemic administration of streptomycin and para aminosalicylic acid.

Keratosis pharyngis has been reported in the past by many different names and most authors believe it is due to fungi of the Leptothrix species, however, Vaheri[12] who made a rather complete study of 21 cases involving principally the tonsils and the base of the tongue, found Leptothrix in no case. Friedlander's bacillus and a streptococcus were most frequently noted. In the cases in which tonsillectomy was done cartilage was commonly found in the tonsils. Keratosis pharyngitis is believed to be a slowly progressive chronic, self limiting, inflammatory process. Tonsillectomy is advisable when the tonsils are involved.

Shnee[13] writes an all too short article on a tremendously interesting subject because of the bizarre symptoms which challenge and frequently baffle the diagnostic acumen of the clinician. Patients with paresthesia of the pharynx are frequently seen in the office and, according to Schnee complain of soreness, dryness, burning, choking tightness, tickling, itching and even mild dysphagia. Frequently no organic cause can be found to account for these symptoms. The diagnosis is made by a process of elimination. Consideration must be given to such possible causes as hysteria, neurosis, anemia, hypochondriasis and the menopause.

Schnee reports a case in which tightness of the throat, a sensation of a lump and difficulty in swallowing were the chief symptoms. The only finding on clinical examination was a tender spot on the right side of the neck above the hyoid bone. Injection of the superior laryngeal nerve on the right side relieved the symptoms for a period of two months. When these recurred, incision in the neck over the tender spot disclosed an enlarged cervical gland pressing on the superior laryngeal nerve. Two years after removal of the gland there was complete relief of symptoms. The report of this case is considered important because it proves that frequently meticulous examination will indicate a diagnosis in an otherwise obscure condition which, because of lack of obvious disease, is too often called globus hystericus

After a brief discussion of pharyngeal infections, Folken[14] reports a case in a boy 14 years old, complicated by erosion of the internal jugular vein Despite vigorous attempts to control bleeding, repeated hemorrhages occurred, which proved fatal

During the summer of 1949 and 1950, David and associates[15] observed a group of children, mostly under five years of age, in Jacksonville, Fla , who presented a clinical picture of sudden illness with fever, usually of 48 hours' duration, malaise and anorexia Examination revealed vesicular or aphthous lesions of the soft palate and anterior faucial pillars The clinical course of the patients and the appearance of the lesions were strikingly uniform A viral agent pathogenic for suckling mice was isolated from throat secretions of 12 of 13 patients with this disease This viral agent was shown to be similar, but of a different serologic type, to the virus isolated in 1948 by Daledorf and Sickles and later designated as the Coxsackie virus Fortunately, the condition was self-limited, seldom lasting longer than two days, however, the ulcers sometimes persisted as long as seven days The isolation of the Coxsackie virus from all cases shows the existence of a definite relationship with the clinical disease described by David and associates

DIVERTICULA

Crile and Robnett[16] report 11 cases of pharyngoesophageal diverticulum treated satisfactorily by simple inversion of the sac Briefly the technique is as follows The incision is made in the usual manner The sac is dissected free up to its neck, a purse string is placed around the neck and the pouch is inverted into the esophagus An Ewalt tube is passed into the stomach The overlying muscle is closed The Ewalt tube is removed and the wound closed Tube feeding is not required The procedure is aseptic and requires short postoperative hospitalization

Peickoff[17] reports a case of pharyngeal diverticulum in a man who first noticed, five years before, that on swallowing solid foods, something stuck in his throat and caused him to choke and regurgitate undigested food Similar episodes recurred on unpredictable occasions Symptoms became more aggravated and soon a peculiar noisy click followed by a gurgle on swallowing developed So annoying was this to the family that eventually the patient refused to have meals with his family or strangers, however, he considered the pouch to have one advantage he noted that at cocktail parties the first few swallows of liquor lodged in the pouch which had become quite large Later in the evening he noted that he could have an extra drink when he needed it by pressing the pouch with his thumb A description of the usual technique for diverticulectomy is included

Hudson[18] states that few surgeons have the opportunity of studying pharyngeal diverticula because of its rarity All observers, however, are agreed that as the pharyngeal pouch increases in size it tends to obstruct the esophagus by direct pressure when distended with food this increases the symptoms and causes anxiety and discomfort to the patient with loss of weight Hudson reports nine cases of pharyngeal diverticulum in which the patients complained of discomfort on swallowing, choking sensations regurgitation and unpleasant taste in the mouth, together with loss of weight depending upon severity of symptoms Hudson considers nocturnal dysphagia with cough of great diagnostic importance All nine patients were treated by the one-stage operation the technique of which is described in detail Hudson believes that the transverse fibres of the cricopharyngeus muscle situated caudal to the pharyngeal pouch is responsible for the formation of the diverticula and this muscle is divided at the time of operation He warns against exerting too much traction on the pouch for fear of amputating too much pharyngeal or esophageal mucosa Good results were obtained in all except two patients who had to have a second operation because of early recurrence thought to be due to persistence of the transverse fibres of the cricopharyngeus Hudson, therefore, believes that deliberate division of these fibres will tend to produce better results

INSTRUMENTS

Somers[19] describes how a pencil-sized pocket flashlight can be converted into an electrical handle for the standard nasopharyngoscope and points out that the amount of current is just right

Inspection of the nasopharynx before, during and following adenoidectomy is essential for performance of adequate adenoidectomy, since the form of the nasopharyngeal space varies widely in different individuals Toward this end, Neivert and Kallen[20] present a simple palate retractor which doubles as a tongue protractor and greatly facilitates direct inspection of the nasopharynx It consists of a flat piece of metal seven inches long and five-eighths inch wide with one sharply angulated end The remainder of the strip is gently curved

IRRADIATION

For many years hyperplasia of lymphoid tissue in the nasopharynx has been treated by irradiation In a most informative manner, Garland and associates[21] discuss the relative merits of Roentgen and radium therapy for benign conditions In an attempt to determine which of these two methods is the most effective and what the actual results of treatment in practice are, they reviewed several hundred cases They present an excellent discussion of pathologic considerations in which the mechanisms of aero-otitis and secretory otitis are described The treatment of choice in hyperplasia of the lymphoid tissue is radiation therapy and the radium applicator is easily applied to the nasopharynx with the aid of local anesthesia Beta Roentgens extend only about 1 cm and are thusly absorbed

Garland and associates believe that the simplest and safest method of irradiation of lymphoid tissue in the nasopharynx is external administration of Roentgen rays The only disadvantage of this type of therapy is that six treatments are necessary instead of the usual three with radium. Anesthetization is not required, and children readily submit as soon as they learn that the initial treatment is painless The great advantage of Roentgen therapy is that the whole lymphoid bearing area of the nasopharynx is included in each treatment. Usually six treatments are given at weekly intervals The technique is described Garland and associates review the results of radium treatment reported in the literature and present their results of Roentgen therapy in 720 cases of lymphoid hyperplasia Fifty-five per cent of adults with deafness secondary to hyperplastic lymphoid tissue were cured with a single course of treatment and 60 to 90 per cent were relieved of presenting signs or symptoms

If Roentgen therapy is as good as proclaimed by these authors, radium therapy would be quickly discarded and all patients with lymphoid hyperplasia together with their complications would be quickly cured This is a most excellent and rather convincing article however the impression is obtained that the authors are somewhat prejudiced

Hardy and Bordley[22] give a report on a screening program in the public school system of Baltimore in which the use of the nasopharyngeal radium applicator in cases of lymphoid hyperplasia of the nasopharynx in children was tested This report consists entirely of testing methods used, methods of analysis of results, and the like and does not give any clinical data or results

Ballantyne[23] studied 48 cases of deafness due to Eustachian tube obstruction encountered over a period of 18 months In 37 cases one tube was irradiated in the usual manner and the other ear maintained as a control Eleven patients had no treatment Audiograms were obtained one month three months and six months later The results were contrary to what one would expect In the 37 cases in which one ear was treated, improvement occurred as often in the untreated as in the treated ear Improvement was noted in 60 per cent of the treated cases and in 82 per cent of the untreated cases

Weisman[24] attributes the occasional failure of tonsillectomy and adenoidectomy to produce the desired results of well-being to the fact that even after an expertly performed operation, remnants of infected and hypertrophied lymphoid issue remain He describes Waldeyer's ring and adds that frequently lymphoid tissue is seen as discrete follicles on the posterior pharyngeal wall The nasopharyngeal Beta radium applicator has been used in the treatment of some of these cases The small localized area affected by the radium applicator limits its usefulness in many cases Because of the ease of application, Weisman prefers Roentgen therapy directed to the nasopharyngeal region, and since lymphoid tissue is extremely radiosensitive, this tissue melts away long before any noticeable effects are produced on any of the neighboring structures

SURGERY

Reeves[25] points out that hypertrophic salpingopalatine folds, or lateral pharyngeal bands, may cause nasal obstruction even after an adequate adenoidectomy Two cases are presented in which relief was obtained by removal of these folds with an adenoid punch

Conway[26] gives a brief historical review of procedures used to try to attain normal speech in cases of cleft palate He reports his experience in the handling of 38 complicated cases, in all of which at least four previous operations had been performed He considers the use of a combined "push back" procedure and an inferiorly attached pharyngeal flap to be the most successful technique In this procedure the pharyngeal flap is permanently fixed to the soft palate

Hitschler[27] presents a case of a broken needle in the tonsillar fossa Attempts to recover the needle at the time of the operation and some time later by biplane fluoroscopy were remnants over the globe and to suture them to the margin of the wound This affords excellent protection of the globe and preserves and stretches the remaining portions of the lids which would otherwise contract down so much as to be of little use later They heal promptly but buckle considerably so that the new canthus stands out at first, however, as the remaining open wound heals, scarring gradually draws the united remnants of the lid laterally or mesially, depending on the part sacrificed The distorted lids then flatten out against the globe and the shortened palpebral fissure stretches, to approximate its normal length Later a canthoplasty can be done if indicated The result is thought to be superior to using a lined pedicle flap

Lamont[42] describes the multiplicity of possible procedures that can be used about the eye, including local tissue flaps, composite grafts and mucous membrane grafts Ulloa[43] emphasizes the fact that in correcting cicatricial ectropion one must split graft over an area which has been artificially stretched to twice the necessary size in order to compensate for shrinkage of the graft and in order to bring the normal formation of folds and wrinkles on the lids Farina and Piza[44] report excellent results in treating all cases of blepharoptosis by the modified Wiener-Lexer technique regardless of types An unusual type of familial ptosis appearing in middle life is described by Cameron [45]

Welt[46] condemns dacryocystectomies and reports 95.4 per cent successful dacryocystorhinostomies in 150 cases Attention is called to removing ethmoid cells with their mucosal lining when encountered in creating a window The maintenance of such a bony fistula can be achieved when the window is made large and mucosal flaps are brought over its edges so that osteogenesis exhausts itself before the window can close

Strictures of the lacrimal canaliculi can be dilated and a polyethylene tube inserted down to the sac according to Henderson [47] Such a tube has been kept in place as long as 45 days in one case The danger of probing occluded nasolacrimal ducts in infants is discussed by Koke [48] unsuccessful Four years later no symptoms had developed Methods of prevention of such an accident, means of recovery of needles and possible complications are discussed

Since good results have been reported with a dilute solution of procaine given intravenously for a variety of traumatic and painful conditions, Somers[28] decided to test its efficacy in the relief of post-tonsillectomy pain Procaine in 1 per cent and 2 per cent concentrations was administered in different amounts to 41 tonsillectomized soldiers The morning following operation, although some analgesia was obtained and there were no severe reactions or deaths the toxic effects were severe enough to preclude this type of analgesia in post tonsillectomized patients

Pearlman and Loewy[29] analyzed 45 cases of secondary hemorrhage from the tonsils and adenoids in 1,035 cases of tonsillectomy and adenoidectomy as to the barometric pressure changes at the time of hemorrhage No correlation was established, but on the basis of their observations they state that "it is conceivable that the time of occurrence may be altered by prevailing conditions of these factors"

The nasopharynx is one of the most inaccessible areas of the body for diagnosis and treatment. Various surgical approaches to this area have been suggested, but most of them have been unsatisfactory Wilson[30] describes a new surgical approach which has proved satisfactory in his hands. A transverse incision is made in the palate just anterior to the posterior margin of the hard palate and is extended downward at either end along the pterygomandibular raphe. The posterior spine of the hard palate is fractured the tensor palatinus tendons are cut, and the whole soft palate is retracted posteriorly to expose to view the nasopharyngeal and posterior choanae With this approach any surgical procedure desired can be performed in this area The incision is readily sutured and there is no postoperative disability

Sheridan[31] points out the difficulties of doing a complete adenoidectomy He advocates the use of a bent metal suction tip as a palate retractor and a 2 cm laryngeal mirror to provide a better view of the nasopharynx, both before, during and after adenoidectomy

BENIGN TUMORS

Kerwin[32] reports a case of juvenile nasopharyngeal angiofibroma in a boy 16 years of age which was successfully treated with Roentgen-ray and androgen therapy This is a rare type of tumor occurring in adolescent boys, which regresses as maturity is reached The tumor is a benign fibroma, but because of its inaccessible position and sometimes rapid growth, it may be locally destructive The main symptoms are hemorrhage and nasal obstruction Because of the danger of serious hemorrhage, biopsy is not always advisable Since spontaneous regression can be expected with maturity, the most conservative therapy should be employed Kerwin considers radiation and hormone therapy as the best methods of control Large tumors may be resected by electrocoagulation and recurrences may be controlled by interstitial irradiation and androgen therapy

From a histopathologic aspect, nasopharyngeal fibromas are considered as benign tumors, but from an invasive point of view, Paredero del Bosque and Sebastian[33] are of the opinion that they behave as malignant growths From a review of the literature they concluded that nasopharyngeal fibromas are extremely rare in England, not too uncommon in America and common in Egypt These fibromas usually occur in males between 10 to 25 years of age They commonly show spontaneous regression with oncoming maturity The various methods of treatment are reviewed, and the conclusion is drawn that implantation of radium and repeated electrocoagulation yield the best results Nasopharyngeal fibromas are radioresistant Because of extensive and dangerous hemorrhage, surgical excision is seldom if ever used Four cases encountered in the last three years are reported This is a splendid article and valuable because of the review and compilation of opinions of outstanding men in this field

Jepson[34] presents an unusual case of a persistent chordoma of the nasopharynx in which treatment over a long period of time, both by Roentgen-ray and irradiation and by surgical removal, resulted only in temporary benefit. Chordomas are tumors arising from embryonic remnants of the notochord They occur at either end of the notochord and rarely are found in the nasopharynx.

Hoogland[35] reports an extremely rare case of nasopharyngeal cyst of branchiogenic origin in a man 69 years old who complained of pain and deafness in the right ear for six weeks Examination disclosed a soft, fluctuating cyst-like tumor the size of a chestnut in the right side of the nasopharynx pressing upon and obliterating a view of the Eustachian orifice Aspiration of this fluctuating mass yielded 10 cc. of brownish opaque fluid Ten months later the patient still had no complaints and re-examination yielded negative results A diagnosis of nasopharyngeal cyst originating from the first branchial pouch was made It was later determined that 45 years before the patient had a mass below the right auricle, which was considered at that time to be inflammation of the first external branchial cleft. This abscess subsided after incision and drainage Guissani reported a similar case in 1928

Hlavacek[36] reports an unsual case of a woman, aged 45 years, in whom a large hypopharyngeal polyp developed in the mouth after an attempt at strangulation She had had no previous difficulty in swallowing, but the growth caused suffocation which was relieved by its removal The polyp was 21 cm long with a peripheral circumference of 7 cm It was club-shaped and attached posteriorly to the cricoid cartilage Histologic examination revealed mature lipomatous tissue

Penha[37] reports a case of nasopharyngeal fibroma in a hemophiliac patient with repeated hemorrhages which failed to respond to routine general and local treatment. He recalled that the natives of Portugal used the nettle urtica membranacea to stop bleeding, either by infusion or local application of the baked leaves therefore when all other measures failed

Penha employed this common plant which promptly controlled the hemorrhage This same hemostatic agent has been used successfully in other cases Penha is conducting extensive investigation to determine the full therapeutic value of this plant, not only in cancer but also in leucemia

Finerman[38] presents the case of a girl 13 years of age who complained of nasal obstruction of two years' duration, which was caused by a growth in the nasopharynx, proved by biopsy to be a juvenile nasopharyngeal fibroma Considerable reduction in the size of the tumor was noticed six weeks following administration of 1,650 r of Roentgen-ray Six months later the possibility of radon implantation was being considered, as surgical excision was being delayed as long as possible This case is of interest not only because of the rarity of nasopharyngeal angiofibromas but also because some authors have challenged the occurrence of this type of growth in females

MALIGNANT TUMORS

In spite of our increased knowledge of nasopharyngeal carcinoma, Hickey[39] believes that the condition is too frequently overlooked For this reason he presents a brief review of pertinent literature to indicate the trend of changing concepts of the disease and a summary of data from a survey of 25 cases in tabular form The fact that only three have survived more than five years indicates that despite refinements in diagnosis and treatment "one frequently finds oneself baffled and somewhat helpless in achieving more than palliative control of the primary lesions and their metastases "

In an excellent and comprehensive article concerning Roentgen therapy of carcinoma of the hypopharynx, Jacobsson[40] presents an analysis of 322 cases treated beween 1939-1947, 75 per cent of which were in the lower part of the hypopharynx or below the level of the superior border of the cricoid cartilage Sixty per cent of the series were females, in 90 per cent of whom the Plummer-Vinson syndrome was present Treatment consists of 5,700 to 6,000 r over a period of 28 to 30 days This is given through four ports and is guided by beam direction through fluoroscopy An overall five-year cure rate of 14 per cent was obtained The five-year cure rate for lesions in the lower hypopharynx was 17 per cent. These results are much better than those obtained in other series

Rojas[11] reports a case of lymphoepithelioma of the nasopharynx, which was first manifested by glandular enlargement on the right side of the neck Further examination revealed a mass occupying the greater part of the nasopharynx and biopsy established the diagnosis Roentgen therapy was immediately instituted After 6,200 r were given in 29 days, the tumor and the cervical enlargement disappeared Two years later adenopathy developed on the left side of the neck. Cortisone was given for 19 days, after which acute anemia developed, necessitating transfusions More Roentgen therapy was given and all symptoms disappeared

Whereas this is an interesting report, it is probably premature as far as cure is concerned, moreover, the value of cortisone must be questioned as in all probability the good results were accomplished by Roentgen therapy

Epstein[12] advocates laminography in the diagnosis of nasopharyngeal tumors, and he points out that their clinical diagnosis is usually delayed until the appearance of symptoms referable to the eyes, ears or upper nasal passages such as diplopia nasal discharge, nasal blockage headaches poor hearing and palpable lymph nodes These types of tumors usually originate in the soft tissues of the nasopharynx and radiologic identification of alterations in these soft tissues is only occasionally mentioned as an important diagnostic sign Epstein reports 10 cases, the youngest being a boy of 14 years with a nasopharyngeal fibroma and the oldest a woman 67 years old with a large lymphoepithelioma Laminography is ideal for radiologic investigation of the nasopharynx The technique is well described, and the reported cases demonstrate the existing pathologic alterations.

In an excellent thesis for the American Laryngological, Rhinological and Otological Society, Inc , Miller[43] presents the results of a statistical analysis of 102 cases of nasopharyngeal cancer encountered at several hospitals Although his results compare favorably with those of other reported series, this paper is an excellent discussion of this subject and should be read in the original form by neurologists, ophthalmologists and general practitioners as well as otolaryngologists Familiarity with the signs and symptoms might help to reduce the great time lag between onset of symptoms and diagnosis of nasopharyngeal cancer

In addition to a rather complete historical review, a discussion of the histopathology, incidence, pathogenesis and symptomatology of the disease is included The diagnosis can almost always be made by mirror nasopharyngoscopy with the use of the electric nasopharyngoscope The commonest chief complaints are nasal obstruction, cervical adenopathy and unilateral deafness Cervical metastases are present at the time of diagnosis in from 40 to 77 per cent of cases Treatment is confined to the use of Roentgen-ray or radium, or both, and results are poor , however, the five-year cure rate has increased tremendously in the past 15 years, some authors reporting as high as a 25 per cent five-year cure rate

Schoolman[44] urges careful routine examination of the nasopharynx in order to make an early diagnosis in cases of malignancy of the nasopharynx Close cooperation between otolaryngologist and radiologist is essential in the treatment of these cases Prognosis is better in the more radiosensitive tumors

Stock[45] reports the results of a study of the effects of nitrogen mustard and urethane on nasopharyngeal cancer Twenty-five patients with late stages of carcinoma of the pharynx were treated with 0 1 mg of nitrogen mustard per kilogram of body weight daily for six doses In a few cases there was extreme diminution in the size of the gland, and in advanced cases with bony involvement temporary decrease in pain, however, in no case did this temporary remission last longer than four weeks In most cases symptoms were not alleviated and the size of the tumor was not affected

Twenty three patients with hopeless nasopharyngeal cancer were treated with urethane. After an intravenous drip transfusion of 5 per cent glucose in water had been running for a few minutes, 10 gr of urethane dissolved in 20 ml of water were injected into the tube The urethane was then washed through the vein quickly and the drip continued until 1 000 ml of 5 per cent glucose had been given The immediate results in these cases were as follows five showed great improvement, four slight improvement, four no improvement five refused adequate treatment and five died, however, Stock stated, ' So far as can be seen at present, the effect is only temporary, for in most cases where some benefit has been shown, the tumor has recurred fairly rapidly '

Hynes[16] reminds us that extensive cancer involving both larynx and pharynx presents a difficult therapeutic problem for which there is as yet no satisfactory solution Usually such patients are treated by radiation Of 21 patients thus treated prior to 1945, only one survived Twenty of these cases were candidates for extensive radical excision Three patients not included in the radiation series had unilateral neck dissection and pharyngolaryngectomy, two of whom left the hospital in good condition and the third was convalescing at the time of the report The surgical technique, which is described in detail, represents a formidable procedure, but unless such methods are adopted these patients are doomed The salvage is such that the procedure is warranted and it is hoped that more laryngologists will follow Hynes' practice

Martin and Quan[17] present statistical evidence of the racial susceptibility of the Chinese for nasopharyngeal cancer They suggest as an explanation for this a racial or hereditary tendency rather than an environmental one as suggested by some From a survey of the literature and analysis of clinical and statistical data from the Memorial Hospital they believe there is suggestive evidence that this susceptibility may be shared by all Orientals except the Japanese

A rare and interesting case of spontaneous pneumocephalus in a patient with extensive carcinoma of the nasopharynx is reported by Raider.[48] The collection of air was apparently both cortical and ventricular, having entered the brain through a defect in the base of the skull caused by the malignant growth. The patient recovered from the pnenumocephalus without untoward effect, but, of course, the carcinoma was not cured, although the patient was alive and showed little change 14 months later.

Seltzer[49] gives a brief discussion of the various types of neoplasms of the nasopharynx. These include nasopharyngeal fibroma, squamous cell tumor, lymphoepithelioma and lymphosarcoma. The most suitable treatment for these lesions is irradiation.

In an interesting and comprehensive article, Digby[50] calls attention again to the fact that the pattern of nasopharyngeal carcinoma varies in different parts of the world. He thinks this is due to the differences in climate, environment, innate hereditary characteristics, customs and habits of the inhabitants. He cites the prevalence of nasopharyngeal carcinoma in Hong Kong, where it is the second commonest variety of malignant disease. In England and North America, nasopharyngeal carcinoma forms only a small fraction of 1 per cent of all cases of malignant disease, whereas in Hong Kong it constitutes 18 per cent of all malignant cases. Many theories have been advanced to explain this high percentage of nasopharyngeal malignancies in the Chinese, but none has been definitely proved. In addition to an excellent discussion of the pathology, Digby describes his method of establishing a clinical diagnosis, which is certainly unique. As in any type of carcinoma, the first principle of treatment is that early diagnosis is essential. The presence of any one sign referable to nasopharyngeal disease demands a thorough investigation of the nasopharynx. Radiotherapy is the best method of attacking these malignancies, since the cells are extremely radiosensitive and usually quick response is obtained. If the case is diagnosed early and treatment instituted immediately, good results may be expected. Unfortunately, too few cases are seen early, consequently poor results are obtained in a high percentage of cases Digby has presented his views and wide experience of years in Hong Kong in an interesting style. In view of the large number of cases he has seen his opinions must be accepted as authoritative

Thompson[31] reports four cases of lymphoepithelioma of the nasopharynx and discusses the symptomatology, diagnosis and treatment of this condition A rather extensive discussion of the microscopic diagnosis of nasopharyngeal tumors is given. It becomes apparent from the divergent opinions quoted that the differential diagnosis of the various types of malignancy of the nasopharynx is extremely difficult This is especially true in differentiating between lymphoepithelioma and transitional cell carcinoma, many pathologists consider them to be the same condition. This article should be read in its original form by those interested in this type of tumor

Malignant neoplasms of the nasopharynx are largely epithelial in origin Squamous cell carcinomas are the commonest, then adenocarcinomas and lymphoepitheliomas Tumors of other origin consist of sarcomas plasmocytomas and lymphocytomas Extremely rare tumors in this area include chordomas, rhabdomyosarcomas and salivary gland tumors In a clear, concise and well organized article, Omerod[32] discusses the signs and symptoms of these tumors, which he conveniently divides into four groups nasopharyngeal, otologic, ophthalmoneurologic and cervical metastatic A number of neurologic syndromes are described and typical case histories are presented

Because of the rarity of radiation cancer in the deep tissue following external radiation, Goolden[31] reports four cases of patients in whom malignant tumors of the laryngopharynx developed following irradiation of the neck for benign conditions In each case 25 years elapsed between the radiation therapy and the diagnosis of radiation cancer A long latent period is characteristic of radiation cancer In most cases of radiation cancer gross changes in the overlying skin are present

Heck and McNaught[54] report two cases of juvenile fibroma which were successfully removed through a transpalatal approach They point out that the advantage of such an approach is that postoperatively the structure is essentially normal as contrasted with the permanent disruption of nasal structures following the transantral approach

Gynning[55] has treated five patients with carcinoma of the hypopharynx by the rotation Roentgen therapy method which is commonly used in carcinoma of the midesophagus Two of these are free of symptoms over seven years after treatment These two cases are reported and the technique, dosage and measurements of the method are discussed

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Epiphoria in facial paralysis is primarily due to inaction of the orbicularis oculi which dilate the lacrimal sac, plus the fact that the punctum is not in contact with the eye and it is usually stenosed McLaughlin[49] outlines steps for correction support of the cheek to ease the pull on the lower lid, restoration of normal tension and position of the lid permanent dilation of lower punctum if necessary by slitting the canaliculus and exposing the sac reduction of size of caruncle if enlarged

CLEFT LIPS AND PALATES

Brown and McDowell[50] first described the small triangular flap operation for the primary repair of single cleft lips in 1945 (see 1946 Service Volume — Plastic and Reconstructive Surgery) and at the present time they reaffirm the excellent results obtained by this procedure Since the main deficiency of tissue in an open lip is a triangular deficiency at the lower border on the columellar side, it seems best to fill in this area by turning down a triangular flap from the alar edge, swinging it across the lower border to fill the defect. Thus extra tissue is put across the bottom of the cleft where it is most needed and a nomal flexion crease is reconstituted with almost no tissue wasted The recently revived and somewhat popular square flap requires converting the triangular defect into a square one, necessitating excision and discard of an additional triangle of tissue The apparent purpose of the square flap is to simulate a cupid's bow, which is definitely present in only a small percentage of normal lips anyway

One method of secondary repair of old cleft lip deformities is by switching a lower lip flap to give needed fullness to the upper lip and better symmetry to the lower Blair and Letterman[51] present a large series of such cases, all of which had had one or more previous advancements of the upper lip Enough tissue can be obtained from the flap to permit elongation of the columella where necessary by means of a "trifoil" or a "batwing" operation

The pattern of growth of the maxillary complex and upper face is comprehensively reviewed by Waldron[52] and a method

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ELECTROCOAGULATION OF THE VESTIBULE IN GUINEA PIGS [*][†]

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St Louis, Mo

Vertigo, tinnitus and deafness are the most prominent symptoms of the condition known as 'hydrops of the labyrinth" Conservative medical treatment may be directed toward improving the basic pathological condition or when medical treatment is ineffective, the function of the affected ear may be eliminated by radical surgical treatment This radical surgery is justified by clinical observations and experiments Vertigo, one of the most disturbing symptoms is due to an imbalance in the activity of the two labyrinths If the activity of the abnormal ear is eliminated, the vertigo improves rapidly and ultimately a stable compensation is reached The experimental work of Bechterew[1] proved that the compensation occurs in the vestibular nuclei When tinnitus is a serious symptom total destruction of the affected cochlea is required

Several surgical techniques have been devised to eliminate the abnormal activity that is the basis of the vertigo and tinnitus. The commonest procedures are *1* sectioning the VIIIth nerve as in Dandy's[2] operation *2* electrocoagulation of the vestibule as in Day's[3] operation, *3* removal of the membranous labyrinth as carried out by Cawthorne,[4] and *4* alcoholic injection into the vestibule[5]

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All of the procedures are usually successful in relieving both the vertigo and tinnitus, but following section of the VIIIth nerve, tinnitus may remain or else reappear several weeks after the operation Sometimes after the other procedures the tinnitus may remain or the vertigo may be induced by particular movements of the head This persisting vertigo is usually attributed to some sensory structure which has escaped destruction by the operation

The original purpose of the present study was to standardize the procedure of electrocoagulation of the vestibule in such a way as to minimize the loss of hearing Subsequently we realized that there is probably no advantage in preserving hearing in hydrops of the labyrinth because the disease has already caused such great hearing loss and in addition there is likely to be severe tinnitus unless all hearing is abolished We undertook, nevertheless, to standardize the electrocoagulation in order to minimize the risk of unintentional injury of the facial nerve and, furthermore, we hoped through histological and pathological stduies to find the basis for the occasional persistence of vertigo and tinnitus following electrocoagulation of the vestibule

METHOD

Experimental Animals

The experiments were performed on 57 adult guinea pigs These animals were chosen because of their suitability for relatively rapid preparation for histological study and because our electrocoagulation methods had been standardized for guinea pigs

Apparatus

A Cameron Duo-Cauterodyne* provided with a special electronic switch for regulating the duration of current flow was used for the electrocoagulation This cautery is a radiofrequency power generator operating at four megacycles The electronic switch consists of a gas tube (No 2051) with a

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*This instrument was generously loaned by the Cameron Surgical Specialty Co

RC timing circuit in its grid circuit and a relay in its plate circuit for turning on the B voltage supply of the Cameron Duo-Cauterodyne The filament current was kept on continuously to avoid the delay of about two seconds required to warm up the filament when the power is turned on by the foot switch supplied with the instrument

Two types of sounds were used for stimulation For pure tones a General Radio Oscillator Type No 1304-A was connected to an attenuator and the output was fed to a Langevin 101 C Power Amplifier which was connected to a Permoflux PDR 10 Earphone. This earphone was connected by an aluminum coupler and a small length of plastic tubing about 3 or 4 mm. in diameter to a small speculum which was sewed into the guinea pig's external canal, forming a closed acoustic system

The other system utilized all the equipment except the pure-tone oscillator Instead of this, it employed a square-wave generator which feeds two sets of band-pass filters set to the appropriate frequency Each set of filters has a nominal cut-off of 18 db per octave The resulting wave form is a brief train of waves which rises to a maximum in three or four cycles and then falls back to a minimum value in three to 10 waves (depending upon the frequency) The repetition rate used for these 'tone pips was usually 20 pips per second

Surgical Procedure

The external semicircular canal was approached through a retroauricular incision. The facial nerve was exposed where it emerges from the Fallopian canal Under a dissecting microscope the bulla was opened immediately above the nerve An opening of about 5mm in diameter gives a full view of the ampullae of the external and the superior semicircular canals The external canal is easily identified by its close relation with the middle ear cavity and the facial nerve.

The otic capsule of the ampulla of the external semicircular canal was fenestrated (In some cases the fenestra was made in the middle third of the external semicircular canal instead of at the ampulla In these cases the approach to the middle third was through a hole entering the bulla between the facial nerve and the styloid process) The membranous labyrinth was then treated by one or another of the following procedures for surgical injury

a *Surgical injury* A fine needle was introduced into the vestibule and swept from side to side in several directions in an effort to destroy all of the sensory structures In a few cases the injury was deliberately confined to cutting the membranous labyrinth just at its junction with the crista and without damage to any sensory structures

b *Labyrinthectomy* The membranous labyrinth was removed from the vestibule by means of a dental broach

c *Electrocoagulation* The needle electrode was introduced into the labyrinth (The shank of the needle was not insulated in any way) In most cases the time of current flow was 0 5 second, but sometimes it was reduced to 0 2 or increased to 1 0 seconds

The intensity of the current was always between 20 and 45 milliamperes

In acute experiments cochlear potentials, both the cochlear microphonics and the action potentials, were observed before and after the surgical injury to the vestibule The electroacoustic methods have been described elsewhere[6] In chronic experiments the cochlear potentials were not observed at the time of operation, but only when the animal was sacrificed

In the chronic experiments the operation was performed under aseptic conditions, and the animals were treated with penicillin for four days after surgery In this group ether anesthesia was employed for the operation, but in all cases dial in urethane was used for anesthesia in the final tests

Following the electrical studies the animals were perfused and fixed The temporal bones were embedded in celloidin Serial sections were cut and then stained with hematoxylin and eosin

RESULTS "ACUTE" EXPERIMENTS

Twenty six ears (20 animals) constitute the "acute" group in which the animals were sacrificed between a few minutes and 24 hours after the surgical injury of the labyrinth The results of the various types of injury were as follows

1 *Surgical Injury*

Only two ears were injured with the needle without electrocoagulation In one the membranous vestibule was destroyed, in the other the membranous labyrinth was cut close to the crista. Microscopic examination of the first ear showed that the crista of the external semicircular canal had been detached and the macula of the utricle was partially injured No damage had been done to the saccule or to the crista of the superior or the posterior semicircular canal (see Fig 1) The cochlea appeared entirely normal on histological examination The cochlear potentials were recorded in this experiment before and after the fenestration Tests were made only at the frequencies 500, 2 000 and 8,000 cycles per second The greatest effect was produced at 500 c.p s where the threshold for both action potentials and cochlear microphonics was elevated by 10 and 16 db, respectively At 2 000 and 8,000 c p s no change of as much as 15 db was produced The ' electrical audiograms" are shown in Fig 2

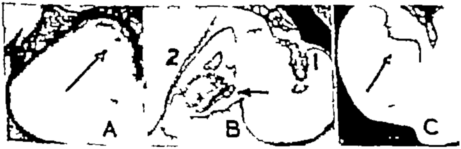

Fig. 1. Injury by needle alone. Survival three hours. (A) Vestibule showing hemorrhage and some pieces of bone Arrow points to the region from which the crista of the external semicircular canal had been totally detached. (B) Vestibule (1) Normal crista of superior semicircular canal and normal macula of the utricle Other sections show some injury of the utricle Arrow crista of the external semicircular canal projecting into the utricle. (C) Vestibule. Arrow points to the normal crista of the posterior semicircular canal

Microscopic examination of the second ear in which the external semicircular canal had been cut showed no damage of the sensory structures either in the vestibule or in the cochlea The electrical responses of the cochlea showed a mild loss of sensitivity at 500 c p s , very much like that in the previous ear

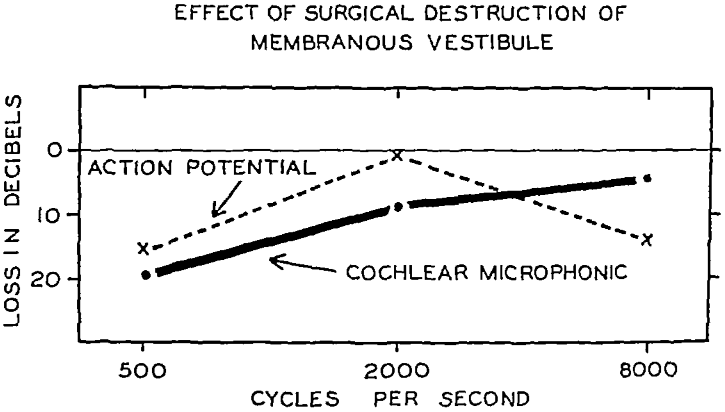

Fig 2 The thresholds were determined before and immediately after surgical injury to the membranous vestibule.

2 Labyrinthectomy

Four ears (three animals) were treated with this procedure Microscopic examination confirmed the total removal of the walls and the crista of the external semicircular canal and of the walls and most of the macula of the utricle In most cases the utricle was severely injured The walls and crista of the superior semicircular canal were damaged or partially removed, but as a rule the crista of the posterior semicircular canal and the macula of the saccule were uninjured The sensory structures of the cochlea were normal

The effect of such labyrinthectomy upon the cochlear microphonic and on action potentials was a mild loss of sensitivity (30 to 35 db) at 500 c p s and little or no effect at 2,000 and at 8,000 c p s

3 Electrocoagulation

A total of 20 ears (15 animals) were treated with electrocoagulation In general this procedure caused necrosis of the crista of the external semicircular canal and the utricle

Sometimes the crista of the superior semicircular canal was also involved The extent of the necrosis depended upon the strength of the current The injury produced by 20 milliamperes (for half a second) was mild, but 40 or 45 milliamperes caused severe injury The mild damage was no greater than what can be produced by surgical injury without the help of the electric current. With the stronger current, however, the injury was definitely greater and presumably was caused by the current (see Figs 3 and 4) Even with the stronger current, however, the crista of the posterior semicircular canal and the macula of the saccule usually escaped injury

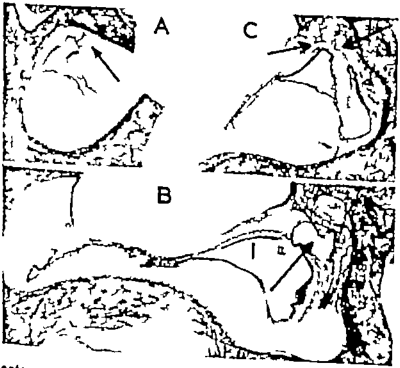

Fig 3 Electrocoagulation by 40 milliamperes for 0 5 second. Survival 0 3 hour (A) Fenestra in external semicircular canal close to the crista. The latter is nearly detached and has been cauterized Arrow points to the path of the electrode (B, 1) Normal macula of the utricle Arrow hole made by the electrode The macula has been partially detached and all of the tissue around the hole shows severe necrosis. (C) The arrows indicate the end of the pathway of the electrode The macula of the utricle and the crista of the superior semicircular canal have been detached from the bony walls. Necrotic tissue surrounds the pathway

The cochleas of this group of animals showed mild necrosis of some of the hair cells of the organ of Corti The injury was most pronounced among the outer hair cells of the first and second turns The stronger the current the greater was the extent and severity of the injury In the experiments in which the animal was sacrificed and fixed within the first 24 hours no structures in the cochlea other than the hair cells showed any signs of injury

The cochlear microphonics and the action potentials after the operation usually showed a loss of sensitivity of 20 to 30 db at 500 c p s when the coagulating current was 20 to 35 milliamperes This current produced no significant effect on the thresholds for 2,000 and 8,000 c p s

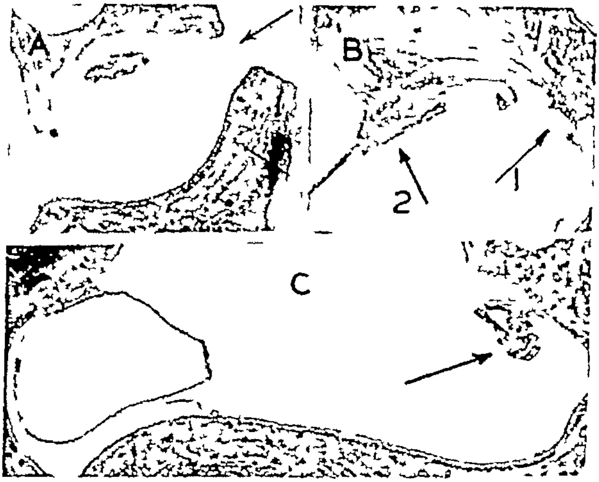

Fig 4 Electrocoagulation by 45 milliamperes for 1 0 second. Survival 1 5 hour (A) Arrow points to fenestra in the external semicircular canal The membranous canal has been reduced to a small necrotic mass (B) Arrow 1 shows where the crista of the superior semicircular canal has been destroyed Arrow 2 points to the partially destroyed and totally necrotic macula. (C) Arrow shows the totally necrotic crista of the exernal semicircular canal

When coagulating currents of 40 to 45 milliamperes were used the loss of sensitivity for the electrical responses was slightly greater Sometimes the responses at 2,000 c p s were unaffected, but in other cases losses as great as 40 or 50 db were found both for the microphonics and for the action potentials The responses at 8,000 c p s were often practically normal In other experiments, however, the threshold was raised by as much as 40 db for the microphonic and 80 db for the action potentials Fig 5 shows a case of such severe injury of repairing the unilateral cleft of the hard palate by means of a mucoperiosteal hinged flap from the vomer is recommended as it interferes least with subsequent growth Any resulting fistulae can be repaired later after eight years of age by the conventional mucoperiosteal palate flaps

For cases of failure of cleft palate elongation, Hynes[53] raises mucomuscular flaps on each lateral pharyngeal wall consisting of salpingopharyngeus muscle and its overlying mucosa He transplants these upward and inward until they lie in a transverse mucosal defect created across the posterior wall of the nasopharynx above the level of Passavant's pad This forms a prominent, permanent and often contractile ridge reducing anteroposterior and transverse diameters of the pharynx without interfering with superior constrictor action It should not be done before 10 years of age

At the time of the last stage of a Dorrance "push back" operation, Marino and Segre[54] suture the posterior border of the velum to a small posterior pharyngeal flap based inferiorly This prevents scar contracture from shortening the palate again and the flap can be divided as soon as this process ends

The importance of cooperation between the surgeon and orthodontist is illustrated by Grundt,[55] who demonstrates types of alveolar clefts that warrant a prosthesis bringing the two parts of the maxilla into correct position prior to surgical closure

Interest in speech rehabilitation of patients with cleft palate is stimulated by Freud,[56] who states that good palate speech is acquired only if a long and mobile palate is created by surgery before definite speech patterns become established, otherwise, speech training is always necessary Peacher[57] describes the speech disorders of all types found in World War II victims

Extensive palatal losses are still best repaired by skin tubes according to Kostrubala,[58] who finds that introduction of the tube into the oral cavity through ways other than the normal mouth opening promises surer results

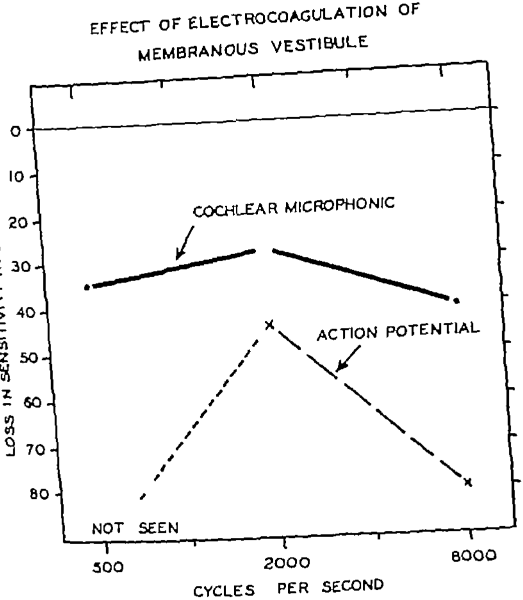

Fig. The "thresholds" were determined before and again immediately after fenestration, followed by electrocoagulation of the vestibule with 45 milliamperes for 0.5 second

RESULTS CHRONIC EXPERIMENTS

Twelve animals (15 experimental ears) were kept alive for periods from one to seven weeks after the operation Considerable difficulty was encountered keeping these animals alive for the desired length of time Twenty-five others died between the fourth and the eighth day after the operation but the ears were not examined histologically because of the probability of autolytic artifacts A few of the 25 animals died from pneumonia, otitis media, or meningitis In others, the most probable cause of death seemed to be inanition, as the animals refused to eat and took very little water

1 *Surgical Injury*

Surgical injury was used in five of the animals in this group with a total of six ears In three of these ears the fenestra was made in the ampulla of the external semicircular canal, in the other three it was made about the middle third of the canal One of the ears fenestrated in the ampulla developed a suppurative otitis media and labyrinthitis In this case all of the sensory structures of the cochlea and the vestibule were destroyed by the infection The fenestra was closed by a mild fibroblastic and vascular proliferatnon coming from the periosteal layer The fibrous tissue showed a pronounced infiltration by leucocytes

In the second ear fenestrated in the ampulla the membranous canal was cut just at its junction with the crista but the vestibule was not injured The animal was sacrificed eight days after the operation Microscopic examination showed that all of the sensory structures of the vestibule and cochlea were normal The fenestra (see Fig 6) was closed by fibroblastic and vascular proliferation that had originated in the

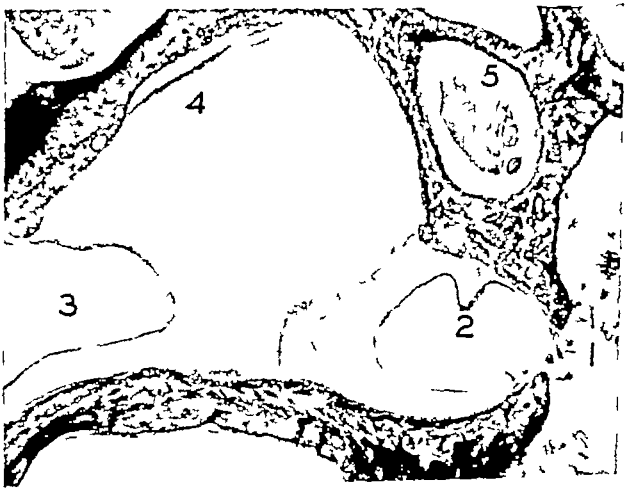

Fig 6 Surgical section of the membranous canal close to the crista. Survival eight days. (1) Fibroblastic and vascular proliferation blocking the fenestra (2) Ampulla of the external semicircular canal with normal crista. (3) Normal crus communis (4) Normal saccule (the collapse of the walls is an artifact) (5) Facial nerve

periosteal and endosteal layers The enchondral layer apparently does not take an active part in the process of repair Numerous bits of bone were found near the fenestra with signs of reabsorption and fibroblastic proliferation Apparently the proliferation around some of the pieces of bone is due to the presence of either periosteal or endosteal tissue Where the fibrous tissue is dense there are some signs of calcification The healing process inside the ampulla presents superimposed and concentric layers of fibrous tissue which extend further along the canal than across the ampulla The cochlear responses, both microphonics and action potentials, for this ear were within normal limits

In the third ear that was fenestrated at the ampulla the vestibule was injured The animal was sacrificed eight days after the operation Microscopic examination later showed both an otitis media and the usual surgical damage to the crista of the external semicircular canal and the macula of the utricle, but the cristas of the superior and posterior canals and the saccule were not affected The healing process at the fenestra was similar to that described in the previous case All of the sensory structures of the cochlea were normal, and there was no sign of infection of the inner ear, nevertheless, the thresholds for both the cochlear microphonics and for the action potentials were elevated by about 55 db The probable explanation of this hearing loss is the otitis media that filled the cavity of the inner ear

In three ears fenestrated in the middle third of the external semicircular canal the membranous canal was destroyed with a fine needle that was introduced in the direction of the ampulla. The animals were sacrificed between three and four weeks after the operation Microscopic examination showed that all of the sensory structures of the cochlea and the vestibule remained normal The fenestra was blocked by fibrous and vascular tissue which filled the canal for a distance of about 1 mm (see Fig 7) The fibrous tissue extended just to the opening of the ampulla Numerous bits of bone were present at the fenestra and in the canal They showed signs of resorption and fibroblastic proliferation, and calcification or formation of new bone could be seen in the dense fibrous tissue at the surface of the canal

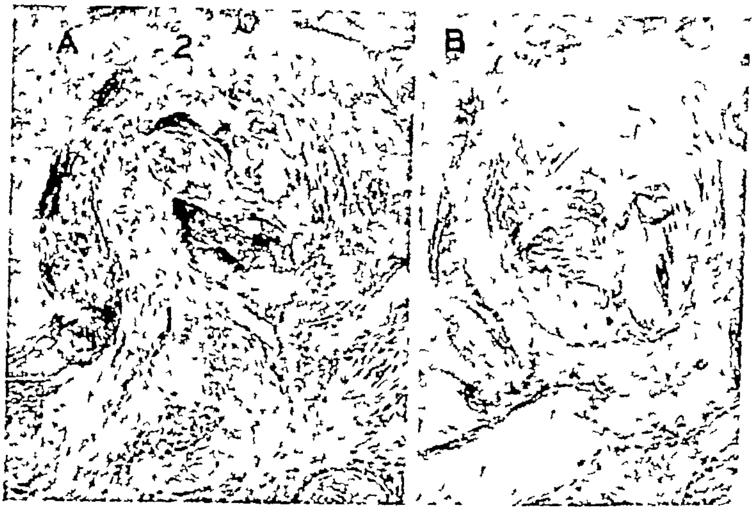

Fig 7 Surgical injury by needle passed along the external semicircular canal toward the ampulla from a fenestra in the middle third of the canal Survival 20 days (A 1) Fenestra filled with fibrous tissue formed from the periosteum. The lumen of the canal is also completely filled with fibrous tissue pieces of bone and new bone (2) Proliferation from the endosteum (B) Same canal about 0 75 mm from (A) The canal is still filled by fibrous tissue and new bone but the tissue is not so dense nor is the formation of new bone so active

2 Labyrinthectomy

No animals survived this procedure long enough to be included in the chronic group

3 Electrocoagulation

Seven animals (nine operated ears) constitute this group In seven ears the fenestration was in the middle third of the external semicircular canal, in the other two the vestibule was coagulated through a fenestra in the ampulla In all cases the current was 35 milliamperes

The first animals were sacrificed at one, four and seven weeks after the operation The three ears taken after one week's recovery showed no damage to the sensory structures of the inner ear and the healing process at the fenestra followed the same pattern as already described The electrical responses were not studied in these animals The only ear taken at four weeks showed normal sensory structures in the vestibule and the usual fibroblastic proliferation and formation of new bone at the fenestra and in the semicircular canal In this ear there was mild atrophy of the organ of Corti and Reissner's membrane was collapsed The thresholds for both microphonics and action potentials were elevated about 20 to 25 db at 500 2,000 and 8,000 c.p s One ear taken after seven weeks' recovery gave no electrical responses Histological examination showed complete absence of hair cells throughout the organ of Corti The supporting cells were normal in the apical turn but showed some atrophy in the first and third turns In the second turn the organ of Corti was replaced by flat epithelium The ganglion cells and the mesothelial cells were uninjured Likewise the saccule and the crista of the posterior canal were normal In this specimen, unfortunately the section showing the utricle and the superior semicircular canal were lost. The other two ears taken after seven weeks recovery showed no damage of the sensory structures either in the vestibule or the cochlea. The healing process in the fenestra (at the middle third of the semicircular canal) followed the same pattern as in the other chronic cases The cochlear responses of these two ears were within normal limits.

The animal in which bilateral electrocoagulation of the vestibule was carried out through a fenestra in the ampulla of the external semicircular canal was sacrifiecd 10 days after the operation It had developed bilateral otitis media and labyrinthitis on both sides The sensory structures of both vestibule and cochlea had disappeared, but on one side the supporting cells of the organ of Corti still remained normal These ears gave no electrical responses. These observations illustrate the special sensitivity of the hair cells to injury, in this case by infection, and also the well established dependence of the electrical responses on the integrity of the hair cells

DISCUSSION

Schall and Rambo[7] used a portable Bovie electrosurgical unit for coagulation of eight membranous labyrinths in five monkeys In one series of experiments the dial setting of the instrument was 20 The current was applied for one second and repeated within 10 seconds In another series the dial setting varied from 10 to 40 These animals were sacrificed after 30 days, while the other series were allowed to survive for periods of 10, 20, 30 and 40 days For a dial setting of 20 or more, they found the membranous labyrinth to be completely destroyed With a setting of 10 the saccule and utricle were incompletely destroyed and the semicircular canals undamaged They were unable to correlate damage to the cochlea with either length of postoperative life or intensity of the coagulating current

In our own experiments the microscopic examinations of the temporal bones show that we did not succeed in producing complete destruction of the vestibule either by surgical injury or electrocoagulation The crista of the posterior semicircular canal and the macula of the saccule remained even when coagulating currents of 40 to 45 milliamperes were used Unfortunately we did not keep enough animals alive long enough to be sure whether these structures would survive permanently or whether they might have degenerated several weeks after the operation

We have no reliable information as to strength of the coagulating current actually employed by various surgeons in Day's operation on the human The results are sometimes unsatisfactory, because after the operation patients sometimes complain of a vertigo, most frequently brought about by nodding the head This relation suggests that the posterior or the superior semicircular canal is still active It is possible that one or both of these canals escape coagulation just as the posterior (and sometimes the superior) canal did in our guinea pigs We believe that electrocautery should be applied several times to the vestibule and with various positions of the electrode in order to reach the posterior semicircular canal of the saccule The intensity of the current must be carefully regulated because it has little effect below 44 milliamperes An electrode insulated except for the tip should localize the current most effectively The insulation would prevent contact with bone at the fenestra and thereby reduce the probability of spread over the surface of the bone to the facial nerve.

In general the heating effect of a brief electrical current is related to its duration as well as to its intensity If brief currents are to be employed, the duration must, therefore, be regulated accurately The delay of two seconds required by the original Cameron Duo-Cauterodyne to warm up its filament makes it unsuitable for such brief dosage The current does not rise to effective strength for two seconds after operation of the foot switch. We suspect that in many human operations in which similarly designed instruments are employed, no actual electrocoagulation is produced The injury may be only from the insertion of the needle

Our microscopic examinations show that a rapid fibroblastic proliferation occurs which sometimes fills the entire closed section of the semicircular canal after two to three weeks. This overgrowth originates from the periosteum and the endosteum The great activity of the endosteal layer is probably stimulated by the surgical injury from the electrode. There is no such fibroblastic proliferation in the vestibule where the space is broad, and hence the injury to the periosteum is minimized.

Coagulating currents of high intensity elevated the thresholds of the cochlear microphonics and the action potentials The elevation of thresholds occurred in the cases that showed necrosis of the hair cells, but the response to 500 c.p.s was constantly affected whatever procedure was used and regardless of any abnormality of the hair cells This effect is probably produced by alteration of the acoustics of the inner ear when the new fenestra is opened. The new fenestra will obviously act like an acoustic leak, and it is reasonable that its effect should be greatest at the lowest frequency

SUMMARY

Electrocoagulation of the vestibule, following the general procedure of the Day operation for Ménière's disease was performed on 57 guinea pigs A special electronic switch was provided to limit the electrocoagulation to a predetermined time, usually 0 5 second Electrical responses to sound were studied immediately or after days or weeks of survival The temporal bones were later sectioned and examined microscopically

Currents less than 40 milliamperes flowing for 0 5 second produced little or no more damage than the mere insertion of the electrode Currents of 40 to 45 milliamperes produced necrosis of tissue near the needle track, but did not injure the posterior semicircular canal or the macula of the saccule Sometimes partial injury of the organ of Corti was produced by such doses

The elevations of electrical "thresholds," both cochlear microphonic and action potential, for frequencies 500, 2,000 and 8,000 c p s , correlate well with the degree of injury to the hair cells in various parts of the cochlea The cochlea was sometimes intact and electrical responses normal four to seven weeks after surgical injury, with or without electrocoagulation of the vestibule with 45 milliamperes for 0 5 second

The surgical fenestras in the labyrinth were closed by fibroblastic proliferation that filled the entire canal New bone was present four weeks after operation The endosteum as well as the periosteum seems to initiate this fibrosis and osteogenesis

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LATE CONGENITAL SYPHILIS OF THE EAR.*†

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There are relatively few diseases of the labyrinth whose pathology is well understood that cause progressive profound hearing loss in the apparently healthy young adult. Malignant otosclerosis is one disease of this group, late congenital syphilis another. The detailed description of the clinical symptoms and the temporal bone findings in late congenital syphilis by Mayer and Fraser,[1] in 1938, laid a firm foundation for this disease entity and separated it from other syphilitic disease of the ear.[2] The main features in this disease are bone lesions of gummatous osteomyelitis. These may invade the labyrinth to produce serous labyrinthitis associated with miliary gumma in the endosteum and dilatation of the cochlear duct and finally pronounced degeneration of the cochlear and vestibular end-organs.

There may be productive inflammatory change in the perilymphatic space of the semicircular canals, sparing the endolymphatic space, and erosions of the endosteal layer of the bony canal may also occur. The ossicles and the annular ligament may be invaded as well as the modiolus. The histological appearance of the subendosteal periostitis of the semicircular canal indicated to Mayer and Fraser alternating periods of exacerbation and quiescence. While the incidence of this particular disease as a cause of deafness in the general population is now very low, the incidence in young adults with profound bilateral progressive hearing loss, excluding malignant otosclerosis, is significant. A re-examination of

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some of the problems associated with the diagnosis and treatment of this disease is presented Only a few studies have appeared in the literature in the past decade

The ear symptoms usually develop rather abruptly long after other active manifestations of the congenital luetic infection have subsided

Despite apparently intensive early treatment and inactivation of early sites of infection, the temporal bone may suddenly become involved in a rapidly progressive disease during the second and third decade of life, even though the patient may be in apparently good general health A clinician actively involved in the treatment of lues may recognize its various manifestations The otologist, however, is usually consulted long after treatment has been terminated Indeed, the patient may have little awareness of the nature of the early infection Early manifestations may not be readily apparent Deformed teeth (Hutchinson's teeth) may have been capped or extracted Interstitial keratitis may have been very mild and after healing may have left very little signs A careful examination with a slit lamp may be necessary to find evidence of the corneal scars Blood serology may be equivocal or negative Laird,[3] in analyzing 115 cases of late congenital syphilis in England, points out that the diagnosis may be obvious or extremely difficult and that one seldom sees infantile syphilis now He found that over 80 per cent of the cases were diagnosed only after the first decade of life and usually because a disease appeared that suggested the need for a blood test

While there were positive eye findings in 61 of his patients, bilateral nerve deafness was noted in only eight Both sexes were equally affected in the eye disease, but seven of the eight cases of ear disease were in females

The direct examination of the ear and results of the auditory and vestibular tests and X-ray were not diagnostic in themselves In the presence of intact, relatively normal drums, the clinician would ordinarily not do a fistula test The presence of a positive fistula response is a rather unique feature of this disease first described by Hennebert[4] in 1911 The

EARS

Byars and DeMere[39] believe there is a distinct advantage in using *fresh* autogenous or homologous cartilage for total ear reconstruction Live cartilage curls toward the perichondrium when split. It curls most in its long axis and additional transverse curling may be obtained by proper thinning In every case it can be counted on to curl enough to alleviate the undesirable flatness so often observed in total reconstructions

The use of autogenous bone and cartilage transplants preserved by *freezing is proposed by Converse*[40] *as this permits* leisurely prefabrication of the ear framework Bone is used to construct the concha and to obtain firm fixation to the skull while rib cartilage makes up the helix and is held to the bony concha by stainless steel wire sutures

A direct mastoid flap is used by Lewin[41] for reconstruction of a helix destroyed by burns, composite grafts, tumors and marginal lacerations If half of the width of the flap is *inserted into the defective margin of the auricle, the other* half which remains unattached will curl until its under surface becomes completely epithelialized By this means distant scarring from a distant skin tube is avoided and economy of tissue and time is effected On the other hand, McNichol[42] contends that the color, texture and size of tubed pedicles from the anterolateral aspect of the neck outweigh the more economical time factor in choosing a site closer to the ear

Fistulae auris congenita are fistulous tracts found in the region of the external ear leading down into the tissues and into blind pouches or cystic dilatations in close proximity with cartilage. They frequently become infected and secrete or extrude a foul material Miller and Moore[43] state that 90 per cent are of marginal helicine location but they may be found also in the preauricular, the crural the posthelicine the postauricular, the helicolobular or the central lobular areas They should be treated with complete surgical extirpation, including the fistulous tract as well as any secondary fistulas which explanation for this phenomenon became clear later when the pathological changes in the temporal bone were described A hastily done fistula test with only positive pressure may show no eye movement or the eye movement may be so brief as to escape notice. Typical nystagmus may be evident only on negative pressure The nystagmus is usually of very short duration (one second) compared to that produced under similar pressure conditions in the ordinary labyrinth fistula (10 seconds) The gummatous invasion of the temporal bone marrow and blood vessel spaces is a striking feature of the disease as described by Mayer and Fraser Both proliferating and destructive changes occur in the capsule bone The labyrinth capsule bone may be riddled with miliary gumma even in the region of the annular ligament. Invasion of the ossicles themselves with secondary ankylosis of the incudomalleolar joint may add a conduction element to the deafness, but bony ankylosis at the stapes footplate was never seen The inflammatory change extends to the labyrinth itself to produce various degrees of chronic labyrinthitis to account for the severe auditory and vestibular symptoms. The symptomatology however, is not particularly distinct and in itself cannot suggest the diagnosis Bilateral symmetrical profound progressive loss, often including low tones without remissions and with various degrees of tinnitus and vertigo is the clinical picture that these patients usually present. The findings in the patients studied are presented briefly including audiograms and vestibular tests to help point out some of the problems in the diagnosis and treatment of this special luetic disease of the temporal bone

Case 1 A. G female age 22 had onset of hearing trouble 11 years ago This became handicapping within a few months There was no tinnitus and only one episode of vertigo Severe interstitial keratitis occurred at age six requiring an iridectomy and producing some visual impairment. She received intensive antiluetic treatment at that time Hutchinson's teeth were present. The blood and spinal fluid serology were negative while under observation in the clinic.

The audiogram demonstrated a profound nerve type deafness bilaterally There was a marked impairment of the vestibular response to the cold caloric test The fistula test was positive to negative pressure in both ears on repeated tests over the period of five years during which the patient was under observation.

A course of fever therapy had no effect upon the hearing The audiogram appeared to stabilize at a very high threshold (see Fig 1) A hearing aid was very effective and relieved tinnitus She was able to attend high school get a job and married

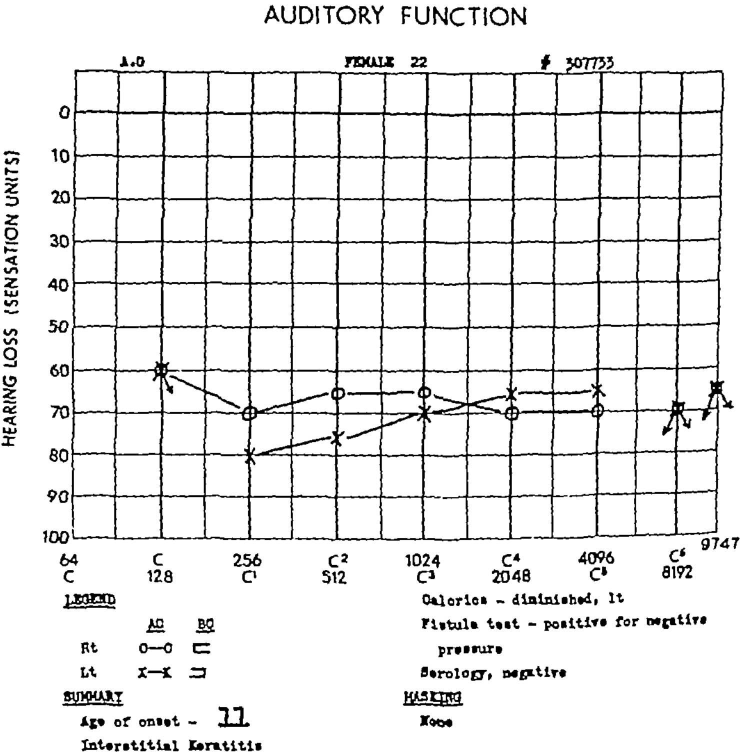


Fig 1 Audiogram of young woman 11 years after the onset of ear symptoms in late congenital syphilis The hearing continued to deteriorate in the face of antiluetic and fever therapy No hearing by bone conduction could be elicited with the audiometer

Comment The response of the fistula to negative pressure is much stronger than that to positive pressure

Based on their pathological findings, Mayer and Fraser explain the fistula response in three different ways

1 A gummatous softening of the capsule from the outside and adjacent to the antrum

2 A gummatous penetration of the bony canal from the inside leading into a narrow space

3 A gummatous infiltration of the stapedial ligament producing abnormal mobility

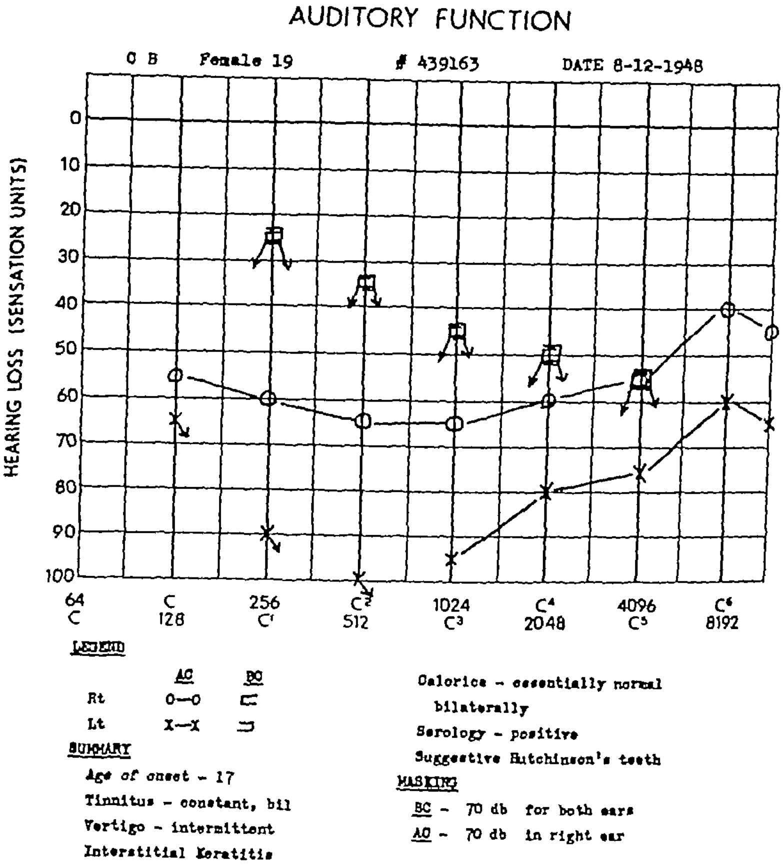
The production of eye movements on pneumatic movement of the intact drum and conducting mechanism is probably the result of unusual, abnormal mobility of the stapes due to invasion by granuloma of the capsule bone in relation to the annular ligament together with limited softening of the bony canal wall from the endosteal surface This explanation is supported by the fact that negative pressure is more effective than positive pressure in producing nystagmus Even the normal conducting mechanism is more easily moved by negative pressure than by positive pressure

The short duration of the fistula response is also a noteworthy feature Only two to three large movements lasting about one second can usually be induced even with maintained negative pressure This suggests a different mechanism of vestibular irritation than that seen in the fistulas of the horizontal canal, where positive pressure is very effective in producing nystagmus and where the nystagmus lasts about 10 seconds with about 15 eye movements of gradually diminishing strength Despite the severe cochlear involvement, the vestibular apparatus was not destroyed The combined impairment of vision and hearing in this patient resulted in severe disorientation with her environment and led to an accident that killed her and her child Unlike some of the patients in this group, this patient went through a pregnancy without change in her hearing, but cochlear function was profoundly affected

Case 2 C. B., female age 23 had onset of progressive deafness at age 17 Within three years the hearing loss was severe and the patient began to have tinnitus bilaterally and dizzy spells The hearing loss increased with these symptoms Evidence of inactive interstitial keratitis was present The serology has been weakly positive Interstitial keratitis was actively treated at age of seven.

The audiogram shows a severe bilateral rather flat perceptive hearing loss, while the minimal cold caloric tests were normal (see Fig 2) The fistula test was equivocal

The patient wears a hearing aid and received symptomatic treatment Regular antiluetic therapy has been given repeatedly



C B Female 19 # 439163 DATE 8-12-1948

LEGEND

	AC	BC
Rt	O—O	⊏
Lt	X—X	⊐

SUMMARY

Age of onset - 17
Tinnitus - constant, bil
Vertigo - intermittent
Interstitial Keratitis

Calorics - essentially normal bilaterally
Serology - positive
Suggestive Hutchinson's teeth

MASKING

BC - 70 db for both ears
AC - 70 db in right ear

Fig 2 Audiogram two years after onset of symptoms in a young woman with late congenital syphilis of the ear Despite intensive antiluetic therapy the hearing continued to deteriorate and two years later the cochlear function on the left was completely destroyed

Comment Repeated and thorough antiluetic regimes did not stop the progression of the cochlear involvement, and the hearing in one ear was completely destroyed

Despite a normal caloric test, some disturbances in vestibular function were present in the patient, as indicated by the occurrence of attacks of vertigo

Case 3 B F female, age 42, noticed a slowly progressive bilateral loss of hearing and slight tinnitus at age 18 At age 35 immediately following her first pregnancy the deafness became profound bilaterally and the tinnitus increased No vertigo occurred Before the onset of ear symptoms the patient had bilateral interstitial keratitis which became quiescent after treatment. A positive blood serology and negative spinal fluid were found at age 18 while during the period of rapidly progressing deafness the serology was only weakly positive or negative on repeated tests.

The original audiogram done in 1945 showed a severe deafness bilaterally Repeated hearing tests (see Fig 3) showed a moderate advancement of the cochlear disease The cold caloric test was reduced on the first examination and was normal on the second On the right ear a fistula response could be obtained on both positive and negative pressure

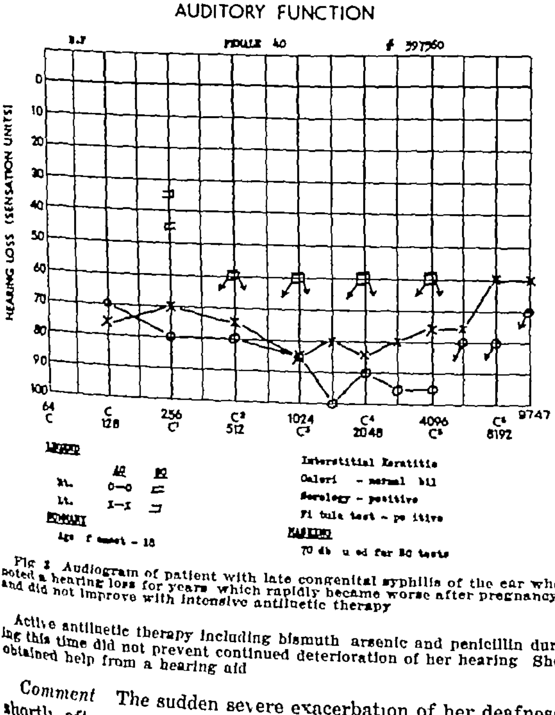


Fig 3 Audiogram of patient with late congenital syphilis of the ear who noted a hearing loss for years which rapidly became worse after pregnancy and did not improve with intensive antiluetic therapy

Active antiluetic therapy including bismuth arsenic and penicillin during this time did not prevent continued deterioration of her hearing She obtained help from a hearing aid

Comment The sudden severe exacerbation of her deafness shortly after pregnancy is noteworthy

Case 4 R. M L, female, age 22, noticed tinnitus and associated loss of hearing at age 17 The hearing loss increased especially in the right ear, as the tinnitus subsided The hearing loss was accentuated during and after a pregnancy There was intermittent, transitory dizzy spells in the early period of the labyrinthine disease Hutchinson's teeth were observed The patient had inactive but handicapping luetic ocular disease that began at five years of age The serology was negative after treatment at age 11 The parents serology was positive

A profound nerve type deafness was present bilaterally with a somewhat diminished response to the cold caloric tests There was spontaneous nystagmus to the left on head shaking The fistula test was positive to negative pressure on the left side

Despite further antiluetic therapy, the hearing continued to deteriorate (see Fig 4)

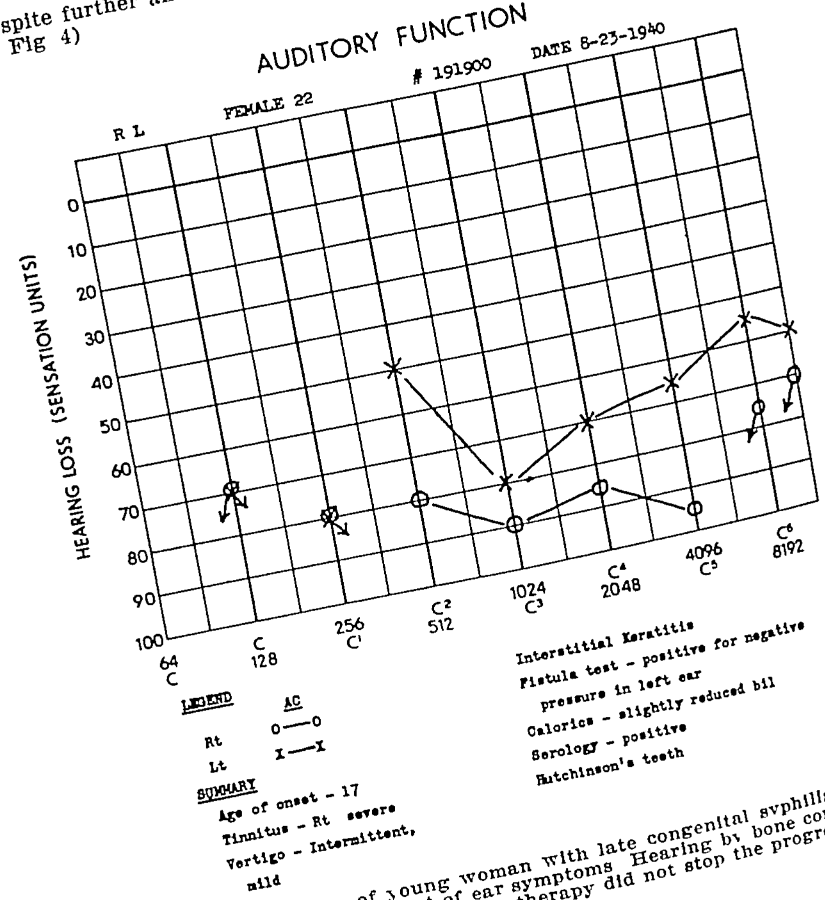


Fig 4 Audiogram of young woman with late congenital syphilis of the ear five years after the onset of ear symptoms Hearing by bone conduction was profoundly affected Antiluetic therapy did not stop the progression of the ear disease

Comment The progression of deafness in face of intensive antiluetic therapy is commonly observed Tamari[8] reported that despite the administration of 9,000,000 units of penicillin in 15 days, both the hearing and the vestibular function continued to deteriorate

On the other hand, when the labyrinth function is profoundly affected, reversal of the labyrinthine pathology by any treatment is not likely

The profound cochlear loss in this patient contrasted to the mild vestibular impairment is in line with the clinical observation of apparent greater sensitivity of the auditory end organs over the vestibular in labyrinthine inflammations The active fistula response to only negative pressure and the history of pregnancy influencing the progression of the deafness are again noteworthy

Case 5 C T., female age 40 noted tinnitus and loss of hearing in both ears at age 35 Following pregnancy at age 38 the hearing loss and tinnitus increased markedly Dizzy spells and headaches followed Suicide was contemplated. The serology has been weakly positive Interstitial keratitis occurred in the late teens but cleared quite well

Cold caloric tests showed reduced sensitivity of the right vestibular apparatus only The fistula response was present on negative pressure in the right ear Intensive antiluetic therapy did not prevent deterioration of hearing.

In July of 1951 the patient received 100 mgm of ACTH per day for seven days while on 600 000 units of penicillin daily for 10 days Pure tone acuity and speech discrimination thresholds were greatly improved

This improvement has been maintained (see Fig 5) With the improved hearing there was an associated decrease in dizzy spells and headaches.

Comment Again pregnancy is seen to influence the activity of the disease Therapeutic problems are discussed below

Case 6 V A., female age 26 was well until the age of 23 when there was onset of severe tinnitus and frontal headaches These persisted for several months before decreased auditory acuity was notice on the left side followed by involvement of the right ear in a few months The hearing loss became progressively more severe in the months that followed. The patient then began to have intermittent dizzy spells and noted an impaired sense of balance more marked at night or in a dimly illuminated room There was a history of keratitis at age of four The patient's mother had received antiluetic therapy just prior to the patient's birth

General examination revealed a widespread vitiligo and a white patch of hair at the nuccal line There was a large inactive central perforation in the left eardrum

Except for inactive interstitial keratitis, iridocyclitis, vitiligo and poliosis, the general examination was negative

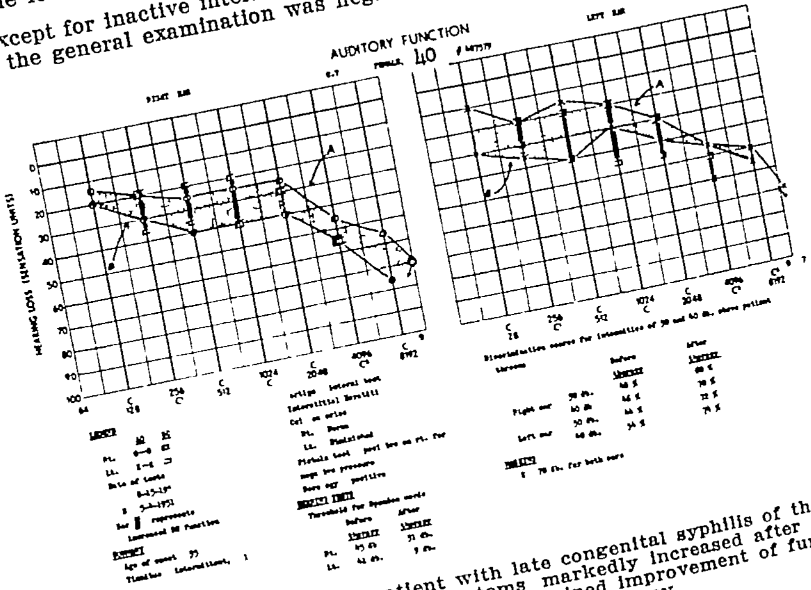


Fig 5 Audiograms of a patient with late congenital syphilis of the ear with five years of progressive symptoms markedly increased after pregnancy three years later and showing maintained improvement of function after a course of combined penicillin and ACTH therapy

There was a bilateral nerve type deafness, more severe on the left side, and bilaterally positive Rinnes with the Weber referred to the right ear There was no caloric response to ice water on the right and non to cold alcohol on the left. There was a spontaneous nystagmus to the right. She had considerable difficulty in walking with the eyes closed The fistula test was negative at this time

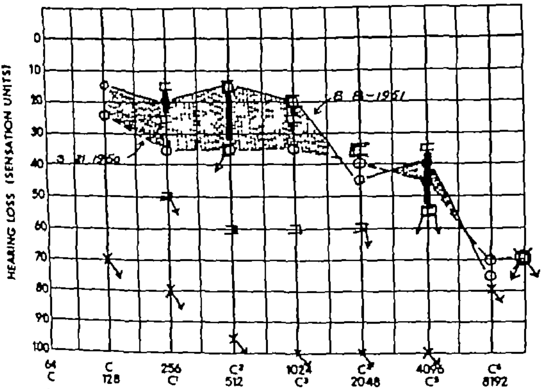
The blood serology was positive, while the spinal fluid was negative In view of the poliosis, vitiligo uveitis and deafness a diagnosis of congenital lues and possibly Vogt koyanagi's syndrome was made

Unlike the other patients in this group this patient after a full course of treatment with bismuth and arsenicals, showed an improvement in the right or better hearing ear A positive fistula reaction was found at this time on the right side, both to positive and negative pressure In March, 1952 she received a combined course of ACTH and penicillin because the hearing had again deteriorated Twenty days later the threshold of the right ear was superior to any obtained in previous tests (see Fig 6) Tinnitus first decreased and then fluctuated a few days after therapy was started

Comment Uveoparotid fever, Cogan's and Vogt-koyanagi's syndromes may be associated with inner ear pathology pro-

AUDITORY FUNCTION

V E A. FEMALE 26 # 487819 DATE 8-8-1951



LEGEND

	AC	BC
Rt.	o—o	⊏
Lt.	x—x	⊐

BC shift

HISTORY

Age of onset 25
Tinnitus present l ft ear
Vertigo mild
ME dry perforation, left
Interstitial keratitis and iridocyclitis
[illegible]
Calorics no response to ice water

Serology - positive
Fistula test positive
Recruitment suggested by discrimination scores

HEARING TESTS

Threshold for spondee word on 8-8-1951
Rt. 29 db
Discrimination score for intensities of 50 and 40 db above patient's threshold

	50 db.	40 db.
Rt.	52 %	46 %

MASKING

BC 70 db for both ears
AC - 90 db in rt ear while testing left

Fig. 6. Audiograms of a young woman with congenital syphilis showing total loss of cochlear function on the left side and moderate loss on the right after about three years of symptoms. The improved function in the right ear after a combined course of penicillin and ACTH therapy is represented. Some improvement was obtained before this by a course of bismuth and arsenicals.

ducing hearing and vestibular loss resembling that seen in late congenital syphilis and were seriously considered in the differential diagnosis in this case, however the eye and ear symptoms in the above diseases are usually concomitant or follow one another rapidly Poliosis and vitiligo is part of the Vogt-koyanagi's syndrome and would be the most likely diagnosis in this case except for the typical history and findings of congenital syphilis and the positive fistula test

In considering the differential diagnosis in all these cases, one may also note that some familial diseases of the ear may manifest themselves long after birth to produce in a rather short time marked auditory and vestibular symptoms in the second to fourth decade of life These are inherited degenerative processes probably affecting the inner ear, often associated with other systemic disturbances

Case 7 M B , female, age 21, had onset of tinnitus at age nine Within two years, the hearing acuity in both ears had decreased to a handicapping level The tinnitus persisted, and in the late teens, transitory vertigo occurred The patient could make herself dizzy by pushing on the right tragus Bitemporal and parietal headaches have been severe in the past three years

There was a history of a positive serology in the patient at the age of nine Her mother had had a positive serology The patient had interstitial keratitis, but this is now inactive The patient's blood and spinal fluid serology are negative at present.

Hearing tests showed a profound bilateral perceptive deafness (see Fig 7) The response to the cold caloric test was reduced only in the left ear There was a slightly positive fistula test to negative pressure in the left ear

The patient received a combined course of ACTH and penicillin for seven days with no effect on auditory symptoms or function

Case 8 A C male age 24, had onset of deafness in the right ear at age 12 This progressed in a few years to an inadequate level and soon the left ear became involved A hearing aid was fairly satisfactory until age 23 when the hearing suddenly deteriorated with an acute "flu"

The patient had interstitial keratitis in 1938 several years before the beginning of ear symptoms, and received antiluetic treatment at that time The mother was a known luetic

The routine clinical examination was noncontributory Hearing tests showed apparent total loss of cochlear function, yet tinnitus was present and sometimes was severe (see Fig 8) There was no response to ice water in either ear The fistula test was questionable in the right ear

A course of continued ACTH and penicillin treatment was given without effect

Comment When the gummatous lesions reach the labyrinth spaces, a rapid progression of symptoms may be expected as labyrinthitis rapidly develops The profound loss of vestibular function together with apparent total hearing may be present due to chronic infection Electrocauterization, Roentgen irradiation, radium and sodium morrhuate injections are to be condemned

NOSE

A completely thorough approach to the immediate management of nasal fractures is given by Roberts,[64] who points out the various deviations and deformities

Converse[65] classifies the various nasal deviations as to etiology and anatomy The rôle of the septum and the correction of the septal deviation is the key to the straightening of the deviated nose The cartilaginous deviations may be handled by a "swinging door" operation, by advancing the lining of the vestibule toward the septum, or by removing the cartilage entirely, trimming it and reinserting it in a reverse position Complete bony and septal deviations require septal resections with incisions in the remaining cartilage, excision of strips making a "swinging door" flap or septal cartilage transplants over the dorsum

The problem of secondary dropping of the tip following rhinoplasty is met by Fred[66] by invaginating the bare edge of the septal cartilage into a prepared groove in the columella where it is held with mattress sutures

Individual variations of alar junction can be classified according to Griesman[67] as cheeked, labial and columellar Excision of triangular, rectangular, trapezoidal, pentagon-like or segmental shaped wedges of tissue from the alar wing or alar facial junction can be used to correct size and direction of nostrils and to control shape of the alae by changing the outer or inner border of alar wings

Collapsing alae may be due to various faults in the upper lateral cartilages, faults in the lower lateral cartilages or faults in the nasal boundaries Fomon *et al*[68] list these numerous etiological deformities and give the proper surgical method of correcting each Where the angle between upper lateral loss indicates a very extensive irreversible labyrinthine infection. The presence of severe tinnitus despite the absence of cochlear function is noteworthy

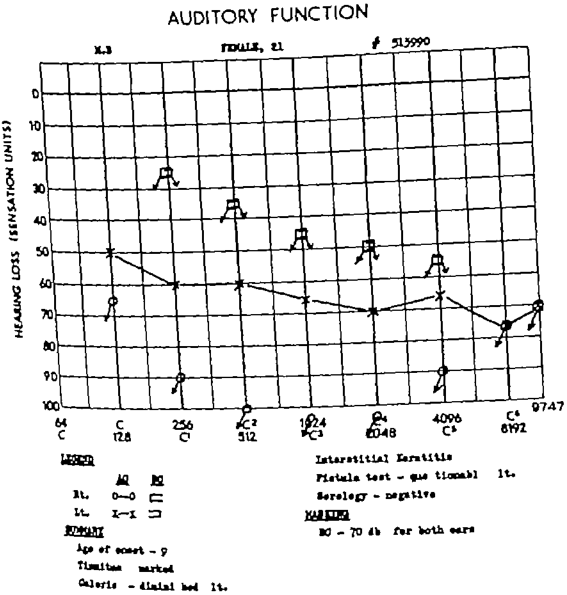


Fig. 7 Audiogram of a young woman with 12 years of progressive ear disease due to congenital syphilis not changed by combined penicillin and ACTH therapy

Case 9 N P female age 29 had onset of progressive deafness at 19 years of age Initially the deafness involved the left ear but, following a pregnancy in 1947 the hearing in the right ear dropped The bilateral nerve type deafness then remained essentially stationary Tinnitus was relatively mild and history of vertigo was vague. Associated with the hearing loss was an inactive luetic interstitial keratitis Positive blood serology and negative cerebrospinal fluid serology were found.

Inactive middle ear disease was camouflaged by the profound nerve type deafness. The fistula test was strongly positive on negative pressure on the left side and weakly positive to positive pressure.

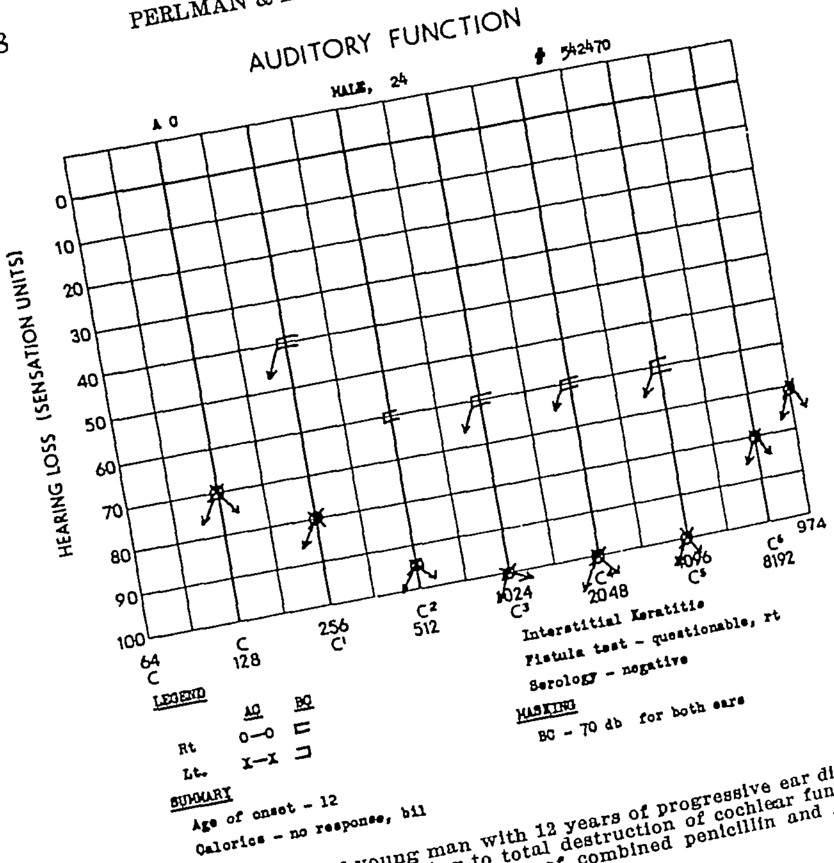
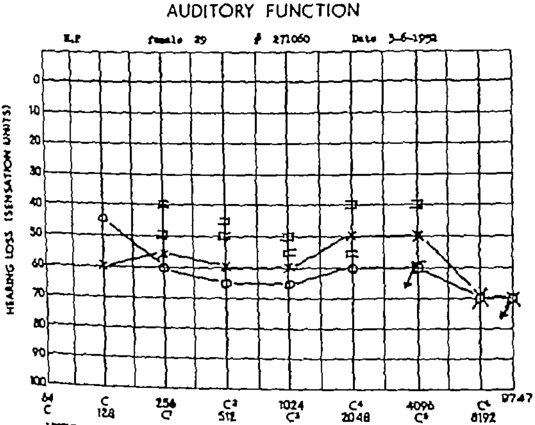


Fig 8 Audiogram of young man with 12 years of progressive ear disease due to congenital syphilis leading to total destruction of cochlear function. No response was obtained by a course of combined penicillin and ACTH therapy

Arsenic and bismuth therapy was ineffective in changing the hearing acuity The patient was treated recently with ACTH and penicillin The pure tone threshold curves were not changed, but speech discrimination tests suggested a significant improvement in the ear with the poorer threshold curve (see Fig 9)

Case 10 E H, female, age 41, had onset of vertigo with tinnitus and hearing loss at age 33 while receiving antiluetic therapy for a second attack of interstitial keratitis The dizzy spells often seemed related to position changes Nystagmus to left with vertigo lasting about two minutes when the patient is lying on the right was noted on Aug 9, 1950 With each dizzy spell, the hearing seemed to become worse

The patient became aware of her lues at age 20 when she developed interstitial keratitis The mother and brothers were also found to be luetics at this time Treatment was given Interstitial keratitis recurred 10 years later The blood serology has been weakly positive over the years



LEGEND

	AC	BC
Rt.	O—O	[
Lt.	X—X	]

HISTORY

Age of onset 19
Vertigo - intermittent, mild
Interstitial Keratitis
Serology positive
Fistula test positi

HEARING TESTS

Threshold for spondee words
Rt. 66 db.
Lt. 65 db.

Discrimination score for tested intensities above the normal threshold

	Intensity	Before therapy	After therapy
	78 db.	4 %	50 %
Rt.	88 db.	16 %	58 %
	98 db	20 %	48 %
	78 db	00 %	4 %
Lt.	88 db	4 %	6 %
	98 db.	4 %	12 %

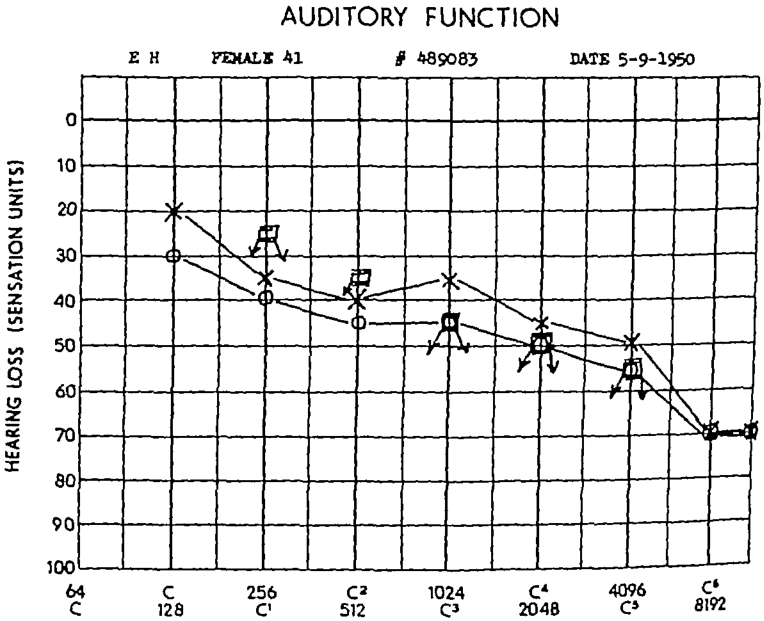
MASKING

80 - 70 db. for both ears

Fig 9 Audiogram of young woman with 10 years of progressive ear disease due to congenital syphilis that did not respond to extended standard antiluetic therapy over this period. A subsequent course of combined penicillin and ACTH therapy was also without clear cut effect.

The threshold curves showed a bilateral moderately sloped perceptive loss (see Fig. 10) The *cold caloric* test showed profound loss on the left and moderate loss on the *right* ear *Positional* changes especially head shaking induced *vertigo* and spontaneous nystagmus to the left. Negative pressure to each ear caused a weakly positive fistula reaction with subjective vertigo

Comment The observed histopathology of late congenital syphilis of the ear suggests that changes in the endolymphatic system of the labyrinth, *i e* dilatation of cochlear duct secondary to invasion of the labyrinth capsule and perilymphatic space by the spirochete may have some resemblance to the changes reported in Menière's disease and may account for occasional similarity of the clinical picture



LEGEND

	AC	BC
Rt	O—O	⊏
Lt	X—X	⊐

SUMMARY

Age of onset - 33
Tinnitus - variable
Interstitial Keratitis
Caloric response
Rt - moderate reduction
Lt - marked reduction

Fistula test - weakly positive
Nystagmus to left and vertigo when patient in right prone position
Serology - positive

MASKING

BC a 70 db for both ears

Fig 10 Audiogram of a patient with eight years of ear disease An attack of interstitial keratitis led to the diagnosis of congenital syphilis at age 20 Her mother and brothers were found to be luetics at this time She was extensively treated but keratitis recurred at 33 and ear symptoms began at this time

Case 11 C W , male, age 35, was a known congenital luetic with positive serology even after intensive treatment at the clinic for the four years preceding the onset of deafness and tinnitus in the *right ear* A year later the patient began to have attacks of vertigo The hearing test showed a flat nerve loss on the right with a practically normal curve on the left. The caloric test, however showed no response to ice water on the normal hearing side and a normal response on the side showing deafness. The fistula test was negative There was a history of earlier inflammation of the eye but no evidence of interstitial keratitis was found. There is however a suggestion of Hutchinson's teeth. The mother was a known luetic.

Comment While this case is included in this report as a known congenital luetic with auditory and vestibular symptoms, the clinical picture is not typical of the group The nature of the right ear deafness and dizziness beginning in the fourth decade is typical of Ménière's disease and may have no relation to the known congenital lues with continued positive serology The absence of a fistula response is not diagnostic, since Hennebert reported that the fistula response was negative in the male with late congenital syphilis of the ear More suggestive of some unusual inner ear disease in this patient is the total absence of the caloric response on the opposite practically normal hearing ear The absence of positive serology in the spinal fluid in this patient, and in others of this group indicates that the meningeal change is not a primary factor in this luetic disease of the ear which begins primarily as a gummatous osteomyelitis of the temporal bone. The major findings in all the above cases are indicated in Table 1

Discussion Like otosclerosis, this disease might be present in the temporal bone for some time before symptoms become manifest. Goodhill[6] found histopathological changes in the temporal bones of luetic infants In those who survive lesions may remain dormant and asymptomatic for years, but finally with invasion of the labyrinth capsule, modiolus or ossicular chain symptoms appear and progress with varying rapidity

The extremely rapid progression of the deafness seen in some of these cases may be due to the widespread serous labyrinthitis initiated when the inflammatory process finally extends through the labyrinth capsule into the labyrinth spaces.

Invasion of the ganglion and nerves in the modiolus may be another important factor in determining the particular course of the disease

TABLE 1 FINDINGS IN THE PATIENTS DESCRIBED

	Family History	Serology	Interstitial Keratitis	Teeth	Age of Onset
1 agk	?	—	+	+	11
2 cb	+	+	+	+	17
3 bf	?	+	+	—	18
4 rl	+	—	+	+	17
5 ct	?	+	+	—	35
6 va	+	+	+	—	23
7 mb	?	—	+	—	9
8 ac	+	—	+	—	12
9 np	+	+	+	—	19
10 eh	+	+	+	—	33
11 cw	+	+	—	+	31

	Tinnitus	Vertigo	Fistula Test Pressure Positive	Fistula Test Pressure Negative	Caloric Normal	Caloric Abnormal	Effect of Pregnancy
1 agk	—	—	—	+		+	—
2 cb	+	+	—	+	+		+
3 bf	+	—	+	+		+	+
4 rl	+	+	—	+		+	+
5 ct	+	+	—	+		+	+
6 va	+	+	+	+		+	—
7 mb	+	+		?		+	
8 ac	+	+	—	?		+	
9 np	—	—	—	+		+	+
10 eh	+	+		+		+	—
11 cw	+	+	—	—		+	

Despite the widespread striking histological changes in the temporal bone demonstrated by Mayer and Fraser, careful X-ray studies have failed to demonstrate them Spinal fluid serology has been negative in all these cases, confirming their opinion that meningeal activity was not an important factor in the disease

The high incidence of this disease in the female is definite, but difficult to explain, as is the aggravation of the symptoms by pregnancy The particular metabolic changes and endocrine imbalance associated with pregnancy sometimes leads to aggravation of chronic systemic infections Clinical observation indicates that local infections like chronic sinusitis or otitis media may become more active and severe during pregnancy The osteomyelitic gumma in the temporal bone and the labyrinth inflammation may thus be activated by pregnancy Since clinical observations indicate that infections may be more severe while patients are under ACTH therapy, the presence of additional ACTH in the blood during pregnancy may be related to the observed progression of the luetic ear diseases at this time. The question of advising against pregnancy even during the inactive stages of this ear disease is worthy of consideration When the patient is seen during pregnancy it may be advisable to give intensive antiluetic treatment, particularly with the signs of reactivation of the infection

Vestibular symptoms as well as abnormalities of vestibular tests are the result of the many degrees of inflammatory changes in the vestibular part of the labyrinth so carefully described by Mayer and Fraser The positive fistula response with an intact drum is a unique feature of this disease and is related to the observed erosions of the capsule bone in the vestibular labyrinth and oval window The ossicular chain probably transmits the pressure in the fistula test and this may explain the marked difference between positive and negative pressure in producing nystagmus Often there is no response at all even with very strong positive pressure The greater sensitivity to negative pressure is in line with the greater sensitivity of the ossicular chain to displacement by negative static and acoustic pressure accentuated at the stapes. The short duration of the induced nystagmus indicates difficulty in maintaining deviation of the cupula by movement of the stapes (see Fig 11) Tammari reports that the fistula test was negative in all eight of his cases while the majority of our patients gave a positive fistula response when negative pressure was used

The rational of ACTH therapy combined with known antiluetic drugs, is the observation that ACTH tends to reduce fibroblast and connective tissue reaction at an inflammatory site. The widespread inflammatory reaction within the labyrinth might be diminished and a similar effect on the luetic lesions in the temporal bone may tend to facilitate approach of the therapeutic agent in the blood stream Any reduction of this connective tissue barrier to the gummatous foci may reactivate them but this is controlled by the simultaneous administration of the antiluetic drug Mayer[7] believed that

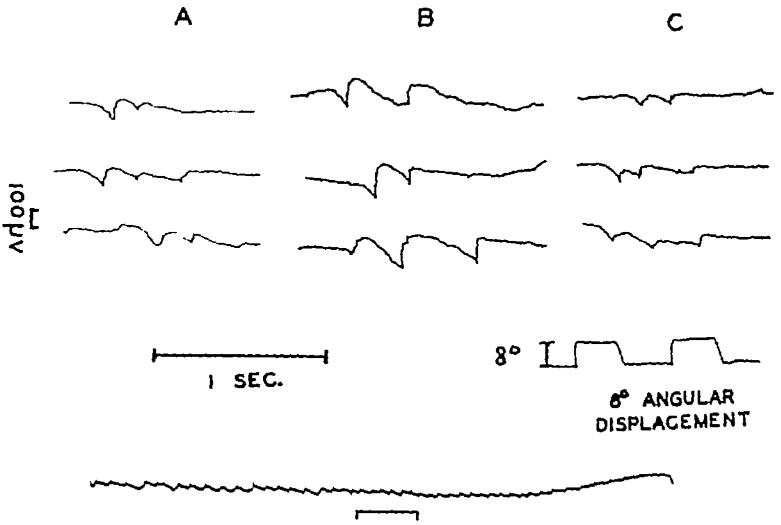


Fig 11 Record of eye movement induced only by maintained negative pressure in the external canal in the case (NP) of late congenital syphilis of the ear (A) Eyes open (B) Eyes closed (C) Eyes open but covered with Bartel s glasses

Note that for each stimulus about three eye movements are produced lasting altogether about one second. The movements are larger when the eyes are closed Compare with record of voluntary eight degree displacement—lower right. More than 10 times as many eye movements lasting about 10 seconds are produced by similar pressure on a fistula of the horizontal canal in chronic mastoiditis (see lowest tracing Note different calibration) Note Records made with the cooperation of Dr T Case

the failure of ordinary antiluetic treatment in this disease is due to the spirochetes being buried in the inactive capsule and he proposed to reactivate this bone and thus mobilize the spirochete so that it might be attacked by the antiluetic drug He cited the experiments of others who produced changes in the labyrinth capsule bone and he proposed a low calcium diet free of vitamin D together with salvarsan as a method of treatment of late congenital syphilis of the ear

The series of cases here reported receiving combined ther-py are of course altogether too limited and the duration of bservation too short to permit any conclusions This disease s so serious, however (complete loss of cochlear and vestibu-ar function may occur), and so resistant to standard therapy that an early test with the combined ACTH and penicillin treatment should be considered Under the combined therapy none of the patients showed further deterioration Some were so severely deafened that irreversible pathology was probably present which could not be affected by treatment.

SUMMARY

Eleven cases of congenital syphilis that developed ear symptoms were studied This ear disease affects young women particularly and is often rapidly accelerated by pregnancy

The auditory and vestibular symptoms and the results of functional tests are compatible with the bone and labyrinth pathology described by Mayer and Fraser

A positive fistula test in the presence of an intact normal drum is a distinctive sign in this disease The response is obtained particularly with negative pressure in the external canal Unlike the usual fistula response, the duration of the induced nystagmus in these cases is usually very brief There are about three eye movements lasting about one second

This ear disease is resistant to antiluetic therapy and may even progress rapidly to profound loss of function during intensive treatment. From a consideration of the special pathology and observations on a few of the patients studied in this report, treatment with penicillin and ACTH when given in early stages appears to offer some prospect for improvement

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cartilages and the septum is too acute, the upper border of the upper laterals may be buckled together onto the septum Where there is abnormal inward bowing of the upper laterals, they may be made to override the lower laterals in reverse fashion A thickened septum may be resected, thickened upper laterals trimmed and lack of resiliency corrected by cartilage implant.

Gerrie, Cloutier and Woolhouse[69] have had experience in 73 cases of using carved cancellous nasal bone grafts from the iliac crest with excellent results Both "strut' and "keel" type patterns of grafts have been used Dupertius[70] has clinical evidence indicating that young human autogenous cartilage grafts show measurable growth over a period of four to six years which may be important in nasal grafts

Cottle *et al.*[71] recommend using hyaluronidase in rhinoplasty, as this spreading factor causes better absorption of fluids and, therefore quicker, more complete local anesthesia without increasing postoperative edema and ecchymoses. The only disadvantage is that the duration of anesthesia decreases but this can be counteracted by adrenalin and frequent reinjections.

Reconstruction of defects in the nasolabial area involving alar border, upper lip and cheek can be accomplished by using a composite graft as outlined by Converse[72] This technique differs from most previous descriptions in that the graft comes from the concha, leaving the helix intact. Repair of the concha is described

Webster and Deming[73] made an analysis of bifid nose and concomitant deformities on the basis of 10 cases An external rather than a blind intranasal approach is stressed The importance of the reduction in the wide spacing of the component parts of the face adjacent to the eyes to produce an optical illusion minimizing the appearance of hypertelorism is realized and accomplished by excision of tissue in the midline of the forehead and bridge of the nose This is supplemented by Y-V procedures on the eyebrows The wide nose is

MASKING AND FATIGUE EFFECT OF WHITE NOISE IN CONNECTION WITH SPEECH TESTS[*]

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The masking effect of noise on the perception of speech has been amply and accurately covered by many authors, with reference to the rational and appropriate employment of the type of masking tone used, less information is available, as most authors in their experiments used the masking tone normally found in ordinary audiometers, this generally comprises a tone spectrum in which low frequencies predominate.

The introduction of white noise undoubtedly presents a progress in that it enables a masking tone to be used, covering with equal distribution the whole frequency spectrum It would be well to remember that the term "white noise" or thermal noise' is derived from the fact that the thermal agitation of electrons in a resistance gives rise to a variable potential across the ends of the resistance itself, the variations are distributed uniformly to cover the frequency spectrum. For our experiments we used an Elit white noise generator supplying a maximum output of approximately 10 mW with a 600 ohm resistance The power supplied by this generator is uniformly distributed between 40 and 10,000 c.s within limits of ±4 db, as measured with a General Radio wave analyzer (see Fig 1)

Using the above apparatus it was our intention to study the masking and fatigue effect of white noise no longer using headphones and monaural reception as had been used previ-

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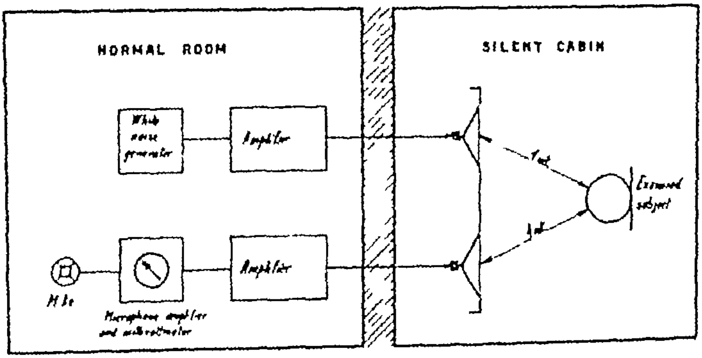
ously by Hawkins and Stevens, Egan, Pollack, but with a loudspeaker acting in free field and using logatomes as test material *

FIG 1



Our research refers to 12 selected subjects with normal hearing The following research method was adopted the subject was made to enter a silent cabin and to sit one meter from the two loudspeakers placed one above the other (one emitted white noise while the other transmitted logatomes), the examiner, outside the silent cabin, was thus able to carry out the articulation curve for logatomes in silent conditions By switching on the white noise generator, he was able to repeat the articulation curves at the following fixed intensity levels of white noise 20, 40, 60, 80 db above normal threshold

Having finished this first part of the test and under identical conditions as previously, the subject being examined was required to listen to the white noise signal strongly amplified (in some cases 60 db, in others 80 db) for 15 minutes with the intention of introducing a state of fatigue, after which

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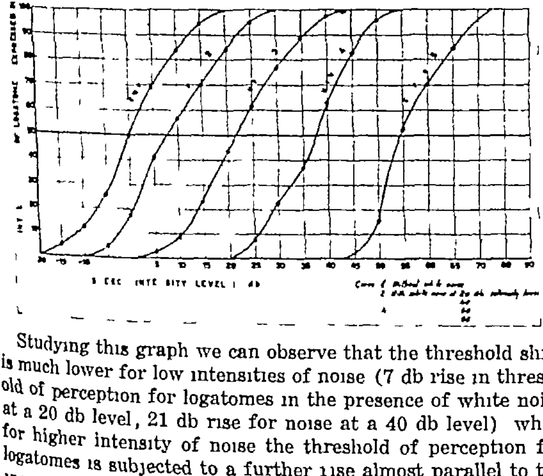
*As phonetical materials were chosen the logatomes constituting an ideal phonetic material where research assumes an essential clinical character as they are a suitable stimulus to the ear only, without interesting superior psychical centers and without identification of the stimulus involving a definite mental engagement. Italian is one of the few languages in the world allowing the use of certain logatomes without subjects being requested to know the so-called phonetic alphabet In the Italian language there is indeed a rather constant correspondence between some graphical signs and the relating phonetic sounds the articulation curve was repeated once more in the presence of white noise at the same fatiguing level and yet again immediately after the noise had been switched off

We will now consider the results obtained during the first part of our research i e , those dealing with the raising of the perception threshold for logatomes in the presence of white noise at varying intensities (in other words, the "threshold shift"), which has already been studied by Hawkins and Stevens for pure tones and for connected discourse in the presence of white noise and, in Italy, by Azzi, in the presence of the masking tone of a normal audiometer (see Fig 2)

FIG 2



Studying this graph we can observe that the threshold shift is much lower for low intensities of noise (7 db rise in threshold of perception for logatomes in the presence of white noise at a 20 db level, 21 db rise for noise at a 40 db level) while for higher intensity of noise the threshold of perception for logatomes is subjected to a further rise almost parallel to the increase in intensity of the noise itself (38 db for 60 db level of white noise and 55 db for 80 db level of white noise)

The above results signify that for low levels of masking noise the ear retains sufficient resolutive power' to oppose the masking effect of the noise itself, while for higher noise levels the masking effect is almost complete

The results show, therefore, that the masking effect on logatomes does not proceed in a strictly linear fashion as in the case of pure tone in the presence of the masking tone of a normal audiometer, but according to a curve which initially takes the form of a parabola, while the latter tends to run parallel to the straight curve representing the behavior of the phenomenon for pure tones This is clearly demonstrated in Graph 3

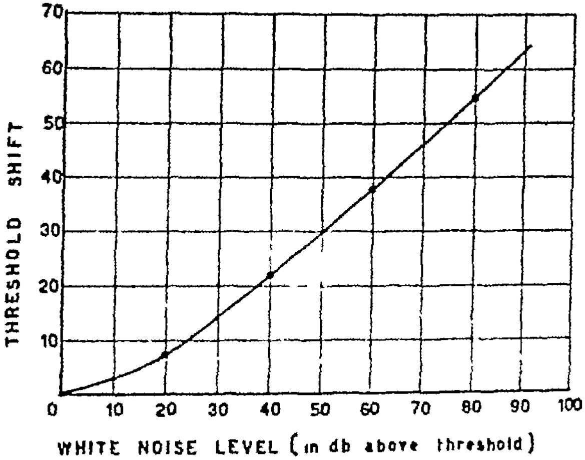


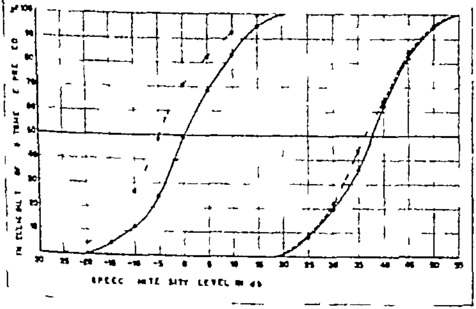
FIG 3

The above affirmation is confirmed in practice by the fact that long distance telephone conversation can be affected in the presence of low background noise level, the noise itself not having sufficient masking effect to impede speech perception

Naturally the resolutive power of the ear is not equal for all subjects with normal hearing, for this reason the threshold shift in the presence of white noise can be recommended as a useful test when selecting personnel for certain occupations where good discriminatory faculties are of the maximum importance (telephone operators, radiotelephone operators, echo-sounding operators, etc) We are here referring, however, to a test which is of interest not only to the otologist but also to the psychologist, since the results obtained depend also upon the phychological factor, the mental response, and in some degree also upon the standard of education of the subject examined

The second part of our research, that dealing with the fatiguing effect of white noise, has provided us with real surprises the articulation curve repeated after 15 minutes of continuous white noise at a high intensity level (in some cases at the 60 db in others at the 80 db level) proved to coincide perfectly with the curve taken in the presence of white noise at the same intensity level before the fatiguing test took place, thus showing that exposure to white noise at the levels used and for the period of time mentioned produces no fatiguing effect whatsoever (see Graph 4)

FIG 4



The articulation curve taken immediately after the cessation of white noise has shown that where we expected to find a rise in threshold of perception we found instead a slight lowering of the threshold itself almost as though the white noise had a "sensitizing" effect rather than a 'fatiguing" effect.

Egan had already found a similar phenomenon but in different experimental conditions *i e*, with binaural headphones The subject being examined was made to listen to white noise at a low level of intensity (45 to 50 db) through one of the phones, while the other was used to transmit connected discourse The A found that when introducing white noise in a phone, perception of connected discourse in the opposite ear was some 5 db better The hypothetical explanation was that the phenomenon was due either to the reflexed contraction of the middle ear muscles of the opposite ear, or else to the fact that as white noise contains all the frequency bands found in common speech, these bands act to reinforce the intensity of the speech fed to the opposite ear It should be noted, however, that the results reported by Egan were later refuted by Pollack

In conclusion, the hypotheses which can be advanced to explain the phenomenon observed by ourselves can be listed as follows

1 Reduction of the muscular tone of the middle ear muscles, and in particular of the stapedium, due to the fatigue of the muscles caused by the prolonged stimulation to which they have been subjected This hypothesis should be linked to the phenomenon of "hyperacusis dolorosa" observed in many cases where facial nerve palsy produces consequent palsy of the stapedium

2 Accumulation of chemical mediators of the nervous system, caused by the sound stimulus, which facilitate the transmission of the sound current through the interneuronic synapsis

3 Psychic effect due to the absolute and sudden silence following a condition of high intensity prolonged noise, causing the subject better to perceive speech, both subjectively and objectively

We are not in possession of experimental data to confirm the first two hypotheses All subjects examined spontaneously observed that they had the subjective sensation of "hearing better", what is more important, however, is that their observations are not only subjective but objective and clearly demonstrated by Fig 4 Neither is it possible to raise the objection that they heard better because of their increasing familiarity with logatomes used throughout the test, first, because our subjects were selected from persons with a good standard of intelligence, who, in the majority of cases, were already familiar with logatomes, second, because the same subject was never presented twice with the same list of logatomes (10 per list) We were in possession of numerous phonetically balanced and, therefore, interchangeable lists

Another objection which could be raised is that if white noise at 80 db intensity level gave rise to fatigue phenomenon, such fatigue could not, in practice, be prolonged over 30 to 35 seconds starting from the moment when the noise itself ceased, while a complete articulation curve takes at least 60 to 70 seconds to complete To these objections we can reply as follows

1 Immediately after the white noise ceased we started taking the articulation curve, beginning at the value of intensity which we had found to correspond with the threshold of perception at the start of the test. This enabled us to bring out eventual differences between the two perception thresholds in less than 15 to 20 seconds

2 Even if we were unable to comply with the time limit as above, we would in any case have found, in the absence of fatigue phenomenon, complete coincidence between the two curves, and not that slight, definite and constant difference which we observed in all our 12 cases

To conclude briefly, the real reason producing the phenomenon observed by us is still unrecognized and for this reason we limit ourselves to reporting it. Further physiological and, above all, physiopathological studies of hearing might give us a better explanation, for this reason we propose to study how the phenomenon and also how the threshold shift, so far observed to be present in subjects with normal hearing behave in cases of otosclerosis and in nerve deafness

SUMMARY

The authors determined the behavior of threshold shift produced by white noise in speech tests with logatomes After

having noted that such shift is proportionately greater for high intensities of white noise, they described the particular phenomenon whereby the ear gains in sensitivity due to white noise They indicate some explanatory hypothesis of the above phenomenon

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AIR EMBOLISM DURING LAVAGE OF THE MAXILLARY SINUS A REPORT OF TWO CASES [*]

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Although the lavage of the maxillary sinus is a simple routine diagnostic and therapeutic procedure, complications can and do occur at infrequent intervals The most serious and most terrifying complication of this procedure is an air embolism. The suddenness of onset, the terrifying train of symptoms and events that follow, the utter helplessness that the otolaryngologist feels and the serious consequences that may follow produce a picture that is unforgettable. To have a relatively healthy individual walk into the office for this simple procedure and then to have a person carried out on a stretcher either dead or unconscious magnifies the gravity of the situation, and justly so This makes it all the more important that we examine all the factors and ask ourselves why this complication occurs and what can be done to prevent it. Certainly, it is our duty and an obligation to our patients that we make this procedure completely safe, so that their health and their lives will be safeguarded.

Grove[1] in his excellent article, gives a historical resume of the introduction of the lavage of the maxillary sinus through the various routes It was Copedepont who in 1894, was the first to introduce the injection of air into the maxillary sinus Since then it was and still is the practice of many otolaryngologists to insufflate air into the maxillary sinus Some injected air into the antrum to determine whether the needlepoint is within the maxillary sinus If the needlepoint is in the sinus, a peculiar gurgling sound of air entering the sinus was supposed to be heard After the irrigating fluid air was insufflated into the sinus to force out the fluid and whatever mucus plugs are present The majority of otolaryngologists do not inject air before the irrigating fluid, but many do so after, in order to dry out the sinus This practice of injecting air into the antrum has led to a number of very serious and even fatal complications

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It was Hajek[2] who, in 1907 at the German Laryngological Society, was the first to refer to this very serious complication which he observed during lavage of the maxillary sinus He attributed this to an irritation of the vagus, cocaine poisoning, hysteroepilepsy and epilepsy From then on, numerous similar cases were reported, some of which led to death and others to recovery All of these had the same train of symptoms, which were characterized by a sudden collapse into unconsciousness, cyanosis, pulse and respiratory changes, tonic and clonic contractures of various groups of muscles and indeed, all muscles, and muscular twitchings No logical explanation was given for this complication and the cause was variously reported to have been due to cocaine poisoning, or a nasal reflex neurosis which was due to an irritation of the vagus through the trigeminal nerve in the nose

Bowen,[3] of Toronto, in 1913, reported two cases of air embolism following antral lavages In the first case, a female became unconscious and had convulsions following a puncture of the antrum and the inflation of air She recovered after being unconscious for five days The second case, a male had a puncture of the antrum and immediately after the insufflation of air became unconscious, had convulsions and died within an hour At autopsy, the heart was markedly distended A hissing sound was heard when the pulmonary artery was opened and the distended heart collapsed The puncture of the antral wall was easily found and when the anterior wall was removed, the mucous membrane of the roof, except for a small part, as well as the outer and inner walls was found detached The mucous membrane covering the roof was hanging about a quarter of an inch below, and it showed a small puncture mark The bone of the roof and posterior wall did not show any puncture mark Consequent-narrowed by fracture of the nasal processes and the use of free grafts of cartilage or excess nasal bone to build up the bridge

A patient with congenital triple nares (one on the right and two on the left) was operated on by Holmes[74] The two nares on the left were converted to one by making the partition into two flaps and transposing them

The development and physiology of the nose and paranasal sinuses is apparently little affected by total unilateral and bilateral choanal occlusion as found by McGovern[75] Of course, in infants prompt surgical correction is required The various procedures are mentioned and the importance of rubber, metal and acrylic tubes or gauze packing to maintain the opening is noted

ZYGOMATIC FRACTURES OR FACIAL INJURIES

The various techniques for elevation of the zygomatic arch and handling zygomatic fractures is reviewed by Hipskind[76] Where there is no comminution of the maxillary sinus but only suture line separation and depression of the arch, he recommends putting a barbless fish hook under the arch and attaching it with rubber band traction to an elastic headpiece by means of a tongue blade fulcrum

Fryer[77] describes a simple direct approach to reducing a fracture-dislocation of the zygoma by entering the antrum through a buccal fornix incision, and with an elevator or Kelley clamp elevating the fragments into place The antrum is then packed with iodoform gauze impregnated with balsam of Peru The pack is left for 10 to 14 days Further fixation of the zygoma in occasional instances of persistent displacement may be secured by Kirschner wires A similar procedure is described by Kleitsch,[78] who occasionally supplements it with a screw in the maxilla and overhead traction McKenzie[79] also packs the antrum but leaves the pack in place only 48 hours Monocular blindness as a complication of the treatment of malar fractures is reported by Gordon and Macrae[80] ly, the needle did not puncture beyond the antrum Bowen postulated that the needle punctured the mucous membrane of the roof, and the air was forced between the mucous membrane and bone, opening up numerous capillaries, thus allowing the air to pass into the general circulation

Boenninghaus[4] and Gording,[5] in 1920, were the first to point out that the cause of these serious symptoms was an air embolism. Boenninghaus found that all these cases had one thing in common the symptoms usually followed injection of air into the maxillary sinus He expressed himself as not believing that these mishaps were due to cocaine and novocaine poisoning While he did not deny that vagus excitation may arise from too strong air pressure or too cold an irrigating fluid, he did not believe it possible for this factor to function to such a degree as to produce an actual death He reported 11 fatal cases in which autopsies were performed and concluded that the air reaches the right heart through the facial veins by the internal jugular vein, but that it may also cause death by hitting the breathing center in the medulla.

Gording,[5] in 1920, collected nine cases from the literature and reported four of his personal cases and another three related to him by his colleagues. There was one death in his own four cases He felt that the cause of the trouble was an air embolism and was able to prove this experimentally in rabbits. By injecting air into the maxillary sinus of the rabbits he could produce changes in the respiration down to complete cessation although no changes in the pulse were noted In one of his rabbits, he produced respiratory changes on irrigating one antrum but on irrigating the other side convulsions and death ensued At autopsy it was seen that an incomplete puncture had been done and that the mucosa of the sinus had been stripped from the nasal wall, occasioning bleeding There were air emboli in the right heart and in the general circulation He concluded that in thick walled antra where the puncture is made with difficulty, it is possible to loosen the mucous membrane from the underlying bone and open up the blood vessels In these cases the mucosa is pushed ahead of the needle and on inflation air is then directly forced into the circulation, therefore, he assumed that in the cases where the bony wall was thick and collapse came on immediately after inflation, the cause was air embolism In the other cases where the bony wall was thin and the symptoms did not come on until actual syringing began, he assumed that a trigeminal reflex could be the cause of the catastrophe Grove[1] does not believe that this latter point is correct because with the syringe used, very little time is lost between the cessation of the inflation and the beginning of the irrigations, and it might easily take the small interval of time for air which had entered the circulation during the inflation to reach the coronaries or vessels of the medulla

Grove,[1] in 1922, made a most complete and exhaustive study of the subject He was able to collect 42 cases of air embolism following antral lavage Of these cases, there were 15 deaths, 11 of which occurred immediately or within a few hours to 36 hours In these fifteen cases, seven followed a puncture through the inferior meatus, three from the middle meatus, while in five cases the route was not mentioned In the autopsies done on eight of these cases, three were entirely negative, in two cases minute hemorrhages or signs of stasis were found in the circulation In a second group of 25 cases the chain of symptoms was the same except for the fact that the patients all recovered after a harrowing experience In these cases the puncture was done through the inferior meatus in 15 cases, through the middle meatus in two cases, and in eight cases the route was not mentioned In the next six cases the common symptom was transitory blindness The most classical example of this was the case cited by Caesar Hirsch,[6] of a 16-year-old girl who, after lavage of the antrum, complained of a sudden inability to see out of one eye The pupil in that eye was immobile, but no pain was complained of An opththalmoscopic examination revealed a pale optic disc, grayish retina and normal retinal veins In the arteries, bubbles of air were plainly visible, separated from each other by columns of blood slowly moving After two or three minutes, the air left the arteries, the retina assumed a more normal color and the disc lost its distinct pallor The activity of the pupil and the sight also returned In these six cases, two followed a puncture through the inferior meatus, three from the middle meatus and in one the route was not mentioned.

Since writing his paper Grove's attention was called to two more cases of collapse during inflation from the practice of two of his colleagues and one case from the literature J C Coffey,[7] of Milwaukee, reported a case of a 54-year-old female in whom, after cocainization, a puncture of the right antrum through the inferior meatus and an irrigation of normal saline was done without incident. The procedure was repeated on the other side with the same anesthesia Considerable resistance was met in attempting to force the water into the antrum, and this caused the patient some pain At the same time only very little water returned. The patient collapsed, became cyanotic and unconscious, with convulsive movements. Death seemed imminent, but the patient recovered after half an hour

Richard Meunzer,[8] of Milwaukee reported a case of an 18-year-old woman who had a puncture of the left antrum air inflation and then was irrigated with normal saline Upon drying out the cavity with air, the patient suddenly collapsed and became dyspneic and had twitchings of the muscles She recovered in two hours A second puncture repeated a week later produced the same train of symptoms

H L Lanier[9] reported a case of a 52 year-old female who had a puncture of the left antrum through the inferior meatus under 10 per cent cocaine anesthesia The puncture was done quickly and easily and the first few injections of air passed through the antrum without resistance Several compressions of the bulb were made in rapid succession when a mucopurulent mass was blown out through the maxillary ostium. After the ostium again appeared to be blocked more air was insufflated The patient fell prostrate became cyanotic the pulse was small and hardly perceptible and the respirations became irregular and shallow The patient remained in this state for three hours and then regained consciousness.

Since Grove's article there has been a paucity of reports in the literature Bacher,[10] in 1923, reported a fatal case with autopsy findings corroborating the results Cavanaugh,[11] in 1925, reported a case of a 35-year-old female who developed a hemiplegia following lavage through the natural ostium and injection of air into the antrum The patient remained unconscious for four weeks and then gradually improved and eventually recovered Goldenburg,[12] in discussing Cavanaugh's paper, mentioned a case of a 35-year-old female who died an hour after a puncture of the antrum and the insufflation of air under pressure An autopsy revealed an air embolism in the heart, and in the coronary, cerebral and mesenteric vessels Lebensohn,[13] also in discussing Cavanaugh's paper, knew of one case where even the air in the tube connecting a Lichwicz needle with a pint piston syringe was sufficient to cause a temporary hemiplegia from which the patient recovered in a few hours

McGovern,[14] in 1941, reported two cases with one fatality The first case, a 24-year-old Negro male, had a puncture of the antrum through the inferior meatus After the injection of air into the antrum he became unconscious, developed severe convulsions and died An autopsy was not performed In the second case, a 24-year-old white female with diabetes had the antrum lavaged through the natural ostium Upon the inflation of air, she became unconscious, and had severe convulsions She subsequently recovered in one week

Bashir, Taneja and Shah,[15] in 1945 described a case of cerebral embolism following the puncture of the antrum and the injection of air The patient collapsed, developed convulsions and paralysis, but subsequently recovered completely

Cornfield and Laszlo,[16] in 1949, reported a death following antral puncture and the insufflation of air The patient, a 46-year-old white male, collapsed and was seized with generalized convulsions, ceased breathing and died in spite of artificial respiration, and cardiac and respiratory stimulants given intravenously and into the heart An autopsy performed six hours later revealed a markedly distended heart and vena cava. There was a loud audible release of air when the heart was opened No air was found in the cerebral vessels The cause of death was reported as due to a massive air embolism.

F J Pinkerton,[17] of Honolulu, has had two fatal cases in his experience. In the first case, a male had a large polyp which protruded from the antrum and a purulent maxillary sinusitis The polyp was removed Three weeks later, a lavage of the antrum was done through the natural ostium The cannula was introduced without difficulty, in fact the cannula "practically fell in' as the operation had left the ostium wide open. During the lavage with the fluid, there was some blood Upon the insufflaton of air the patient fell unconscious, had a convulsive seizure and died within 20 minutes An autopsy revealed air embolism Pinkerton feels that in this case, the lavage may have loosened a few blood clots and left open the ends of a few blood vessels for the entrance of the air In the second case, a male with purulent maxillary sinusitis had repeated lavages through the natural ostium for a purulent infection In what was supposed to be his last lavage, he fell unconscious after the lavage and the insufflation of air had convulsions and died within half an hour An autopsy revealed air embolism

Kelley[18] reported an interesting case of a woman on whom he performed a puncture of the antrum through the inferior meatus On insufflation of air, a low gurgling sound was heard unmistakenly passing down the neck. The patient stated that she felt something passing down the neck but was in no way affected by it Kelley felt that the needle must have passed through both walls of the antrum and opened up a vessel in the pterygoid plexus of veins in the pterygomaxillary fossa and thus air entered into the circulatiin

There is no doubt regarding the manner of development of air embolism The air must get into the circulation in only one way and that is, during the puncture a vessel must be punctured or injured and the air is forced directly into the circulation

Gurlitz[19] has shown that the antral mucosa is very vascular and in 50 per cent of his injected specimens there was a thick venous plexus over the antral wall or orbital wall, or over both walls, that whenever this plexus is present it is usually where it can be easily injured by the puncture. Gurlitz's specimens were those of normal sinuses, moreover, in the infected maxillary sinuses where the antral mucosa is thickened and congested and frequently almost fills the maxillary antrum with loose edematous folds, one would expect to find an increase in the number of blood vessels.

Gording[5] has studied very carefully the mechanism of the development of air embolism. According to him, if the needle is advanced at a slow rate through a thick wall of the inferior meatus, the mucous membrane may be detached over a considerable area, that the blood vessels may be torn in these cases, the air is forced into the torn blood vessels and air embolism results. In Bowen's[3] case, the mucosa of the roof, except for a small part as well as the outer and inner walls, was found detached as a result of a puncture through the mucous membrane of the roof and the forcing of air between the bone and the mucous membrane.

After the air has entered the vein, it then proceeds from there to the right chamber of the heart. From here, opinions in regard to the cause of death differ greatly. Some consider that it is a "lung death" and believe that the air is driven from the right chamber of the heart into the lung capillaries which are embolized and the circulation is interrupted, with death as a result. Most writers are inclined to the view that the cause of death should be looked for in a paralysis of the heart and it should be regarded as a "heart death." In many cases, the predominant symptoms are nervous disturbances. Some workers assume that the air bubbles have passed through the lesser circulation and entered the arterial system, where they caused, through emboli of the brain vessels and medulla oblongata, the periods of unconsciousness, the convulsions and respiratory disturbances, thereby causing a "brain death."

Bergstrand,[20] basing his opinion on his rabbit experiments and clinical observations, felt that the danger with venous air embolism is from a drop in the arterial pressure as the accumulating bubbles of air reach the pulmonary capillaries The slowing of the current raises the pressure in the aortic vessels. This causes an anemia of the brain with neurological symptoms and death He found that paresis, indicating a local injury of the brain, was never noted in the animals or in clinical cases. The blood in the aorta is a dark color, indicating a defective oxygenation, hence inhalation of oxygen seems a rational treatment. Also, by lowering the head the negative hydrostatic pressure of the veins tends to prevent any inflow of air Even after the low pressure has been combatted, the danger is not past as the air accumulates in the right heart. He has never witnessed any benefit from a puncture of the right ventricle in the animals as the air escapes into the pulmonary artery and is not released by puncture. Venesection may give relief with any form of air embolism With arterial air embolism he found that the air enters the left ventricle and passes immediately into the aorta and bubbles are found in the peripheral arteries especially at the base of the brain. He also witnessed the presence of air bubbles in the choroidal vessels of the eye until they were gradually absorbed or swept along He estimated that 75 to 100 cc of air can be borne in a venous embolism without permanent harm, but even 1 cc of air in the artery is sufficient to kill a horse. It must be assumed, then, that in the cases of severe nervous manifestations and of death, the air must enter the arterial circulation It has been proven not only that air in the arterial system passes without difficulty through the lung capillaries but also that air bubbles in the venous circulation may be carried into the arterial circulation

Grove himself, felt that the nervous manifestations would arise during antral inflation if the air pumped into the circulation was insufficient to fill the right heart completely and stop its action suddenly The air would then be forced through the lungs and into the left heart and the greater circulation By passing into the vessels of the brain and the medulla, it would cause symptoms until it was absorbed

Kelley[18] has called attention to the fact that the grave symptoms which arise from the puncture of the antrum and the insufflation of air are strikingly similar to those which occasionally arise during the production of an artificial pneumothorax

The symptoms of air embolism are characteristic and once seen are unforgettable The onset occurs with dramatic suddenness and the patient usually slumps in the chair and becomes rigid and unconscious The unconsciousness is associated with pulse and respiratory changes, cyanosis and then convulsions The respirations may be irregular, stertorous, suspended and jerky, with periods of apnea There may be tonic and clonic contractions of various groups of muscles almost akin to an epileptiform seizure A severe trismus has been noted in several cases The pupils may become fixed and dilated, or there may be a nystagmus, conjugate deviation of the eyes, or a backward rolling of the eyeballs The pulse may be bounding, irregular, rapid or it may even be slow There often is an associated cyanosis or an ashy gray color As a rule, there is an elevation of the temperature Death may ensue immediately or may occur hours or days later Those that survive the initial onset may have transient disturbances of vision, alternating periods of blindness, varying degrees of paresis, paralysis and even hemiplegia, a feeling of fear and suppression, disorientation, mental lapses and other mental symptoms

Grove[1] reported six cases in which the common symptom was a transitory blindness Caesar Hirsch[6] feels that in the cases where visual disturbances exist, the air emboli are visible by immediate ophthalmoscopic examination and are recognized by the pallor of the disc, silvery, narrow arteries with air bubbles within their lumina, normal veins and a slightly clouded eyeground In his case of the 16-year-old girl mentioned earlier, he was able to see the bubbles of air in the retinal arteries

The signs and symptoms of air embolism are so characteristic that once seen they are unforgettable The only condition that may possibly confuse the diagnosis is a severe cocaine reaction In the milder cocaine reactions, there may be a feeling of anxiety, giddiness and fear, motor restlessness, headache, vertigo, hallucinations, extreme pallor and paresthesia The pulse is accelerated, and the patient may experience palpitation The pupils are dilated, and there may be nausea and vomiting In the severe reactions, there is a dilatation of the pupils, dryness of the mucous membrane, vomiting and clouded sensorium There may be epileptiform convulsive seizures that may be brief or more lasting Circulatory and respiratory depression may follow and manifest itself by a feeble pulse, slower and irregular respiration, and cold and clammy skin, Cheyne-Stokes respiration and finally collapse and coma may then occur Death usually results from a paralysis of the vasomotor and respiratory center of the medulla

Thus it can be seen that only the most severe cocaine reactions may cause a confusion in the diagnosis Most of the cocaine reactions are preceded by the premonitory symptoms mentioned above, while in the air embolism the onset is dramatic and sudden The other and most important point is that an air embolism always follows and never precedes air insufflation.

Attempts have been made to determine the frequency of air embolism in relation to the method of lavage of the antrum Air embolism may follow any one of the three methods of antral irrigation. In Grove's death series of 15 cases a puncture was done through the inferior meatus in seven cases through the middle meatus in three cases and in five cases the route was not mentioned. In the next 22 cases, with symptoms very similar to the death cases there were 12 punctures through the inferior meatus, two from the middle meatus, and in eight the route was not mentioned In the six cases of transitory blindness, two followed puncture through the inferior meatus, three from a puncture through the middle meatus, and in one case the route was not mentioned The cases of Coffey, Meunzer and Lanier, that were mentioned by Grove, all followed an inferior meatal puncture

In Bacher's case, the lavage was done through an inferior meatus puncture Cavanaugh's case followed an irrigation through the natural ostium, while Goldenberg's and Lebensohn's cases were through the inferior meatus In McGovern's two cases, one followed lavage through the natural ostium while the other followed a puncture through the inferior meatus The case reported by Bashir, Taneja and Shah resulted from an inferior meatal puncture, as was the case of Cornfield and Laszlo Pinkerton's two cases followed a lavage through the natural ostium, as did my two cases

From this series of 58 cases, 30 followed a puncture through the inferior meatus, 14 from the middle meatus, six from the natural ostium, while in eight cases the route was not mentioned, thus it would seem that this complication is more frequent following a puncture through the inferior meatus Anatomically, this would seem to be borne out by Gerlach's anatomical study which showed that there is a large plexus of veins in the medial wall of the antrum in the region of the points of entrance of the trocar, however, despite these facts, the seeming predominance in the incidence of air embolism following a puncture of the inferior meatus may be due to the fact that this is the route most often used[26]

Nothing much has been written regarding the treatment of this condition From all indications, the treatment does not seem to influence the outcome and is entirely symptomatic Artificial respiration and respiratory stimulants should be given if the respirations stop and circulatory stimulants for cardiac arrest The inhalation of oxygen is a rational treatment in view of Bergstrand's experimental and clinical findings of a general anemia of the brain resulting from a drop in the aortic pressure and the resulting defective oxygenation Also by lowering of the head, the negative hydrostatic pressure may tend to prevent any inflow of air

Slowes[41] has designed a maxillary apparatus and an extra oral clamp splint to be used for associated maxillary and mandibular fractures where both jaws are edentulous or semi-edentulous

FACIAL REPAIRS

Brown[42] and Brown Fryer and Kessler[43] give a comprehensive review of the many surgical procedures on the face for improvement of function and appearance Broad general principles which are applicable are stressed and a variety of associated problems are dealt with

Further attention has been centered on the Treacher Collins syndrome by O'Connor and Conway[44] and the various procedures necessary to restore a more nearly normal appearance are numerous

Converse[45] has had experience with 26 cases of facial contour reconstruction by bone or cartilage grafts introduced through the oral vestibular route and apparently such implants are as successful as those placed through external incisions Visible scars are avoided and excellent exposure obtained Converse and Smith[46] report a case of reconstruction of the maxilla following resection for carcinoma of the antrum. A cheek flap was raised, a bone graft placed on the orbital floor, the depressed area below filled with bone chips, and an overlay bone graft inserted to restore maxillary contour

In Dingman's[47] opinion fresh autogenous bone is the material of choice for the correction of bony deformities of the face and skull The ileum provides an excellent source of abundant material Patterns of the defect are useful aids in the preparation of the graft and 'cast stone" models previously fabricated can be sterilized and used at the operating table as a guide It is felt that there is little or no difference whether the bone is entirely cancellous or a mixture of cancellous and cortical bone if the graft meets the necessary mechanical requirements Converse and Campbell[48] have used refrigerated bone autografts and homografts for facial recon

Bergstrand also mentions the use of venesection In his rabbit experiments, he had never noticed any benefit from a puncture of the right ventricle

The prognosis of air embolism is serious In general, it depends upon the amount of air and the rapidity with which it is pumped into the circulation as to whether the patient is going to die or recover It also depends upon the organ that is involved In the 58 cases that I have collected, there were 23 deaths with a resulting mortality of 39 5 per cent McGovern states that the mortality varies from 15 to 50 per cent and that the patient surviving the first 15 minutes has a better prognosis Just how or where he derived these figures is not mentioned in his article

In many of the cases air embolism was demonstrated at autopsy Air has been found in the cerebral vessels, the mesenteric vessels, the pulmonary artery the juguler veins and in the lungs In a few cases, the right heart was found distended with dilated pulmonary arteries and hissing of air was heard on the opening of the heart and pulmonary veins, however, in many cases, the presence of air was not demonstrated Grove feels that even in those cases of death in which no air was found in the circulation on autopsy an air embolism which was overlooked might have been present in the coronary arteries or in the vessels of the brain It is easy for pathologists to overlook this factor, for few of them think of opening these organs under pressure unless the clinician specifically requests it.

How can we prevent air embolism following a lavage of the antrum? This is a most important question in view of the severity of this condition Although air embolism is supposed to be relatively rare, it probably is more frequent than is reported because many surgeons are either loathe to report their bad cases or are too busy and lack the time and energy to do so, furthermore it could be that many cases of air embolism were probably diagnosed as cocaine reactions In my opinion the only sure way of preventing this complication is to discontinue entirely the insufflation of air into the maxillary sinuses

It was formerly the practice of the older otolaryngologists to insufflate air into the antrum before irrigation and again after irrigation to dry out the sinus This practice of insufflating air before the irrigation to determine whether the point of the needle is in the sinus and whether the ostium is patent, is entirely unnecessary If the point of the trocar or cannula is within the sinus, it should be freely movable and there should be no pain or resistance during irrigation If the point of the needle has passed through the nasal and lateral walls of the sinus from the inferior meatus or through the nasal and orbital walls from the middle meatus, its shaft will not be movable At any rate, should there be any doubt about the correct position of the needle, a small syringe may be used first to withdraw air, pus or mucopus from the sinus before irrigating the field

It is also unnecessary to dry out the sinus after irrigation, because there is absolutely no harm in leaving a small amount of saline solution, boric acid or any other mildly antiseptic solution in the antra after the gross products of infection have been removed Normal saline in itself is stimulating to the cilia and any irrigating fluid is rapidly emptied by the ciliary action or by changing the position of the head or by blowing the nose

There seems to be little or no disagreement among modern day otolaryngologists regarding the insufflation of air into the antrum prior to the irrigating fluid This practice has been discarded by nearly all otolaryngologists and has been discouraged by all textbooks and the postgraduate schools of otolaryngology, however, there still is a disagreement regarding the question of inflation of air into the antrum after the irrigating fluid In a review of the textbooks of otolaryngology, it is seen that most authors advise against this practice Hajek,[2] Morrison,[21] Turner,[22] Lederer[23] and Neivert[24] warn of the danger of air embolism Lederer further advises the evacuation by suction and then irrigation with normal saline followed by suction evacuation again Phillips[25] and Van Alyea[26] advise the use of air after irrigation Van Alyea states that, "Inflation following irrigation removes the residue to the solution and helps to promote early restoration of function. The dangers associated with inflation are contingent upon the presence of the cannula tip in the nasal or sinus mucosa. This is not likely to be the case if the sinus has just been irrigated and its contents removed. When a return flow has been established one may be sure the tip is not imbedded in the membrane. The injection of air preceding lavage, when there is some doubt as to the exact location of the tip, accomplishes nothing and may carry with it some element of danger. Its use should be discouraged as hazardous and worthless procedure."

There is also a difference of opinion regarding this point in the teachings of the various medical schools which conduct a graudate course in otolaryngology. Schools which teach their students to inflate the sinuses after the irrigating fluid include the University of Pennsylvania,[27] Washington University of St. Louis[28] and New York University.[29] Schools that advise against the inflation of air include Northwestern University,[30] Harvard University[31] and Tulane University.[32]

Personally, having had two unfortunate experiences I am strongly opposed to the inflation of air into the antrum, especially since I can see no advantage in doing so. During our training and residency days, we were taught to lavage the antrum with normal saline, using an irrigating bottle connected with compressed air. It is quite possible for air to escape before the fluid or to be mingled with the fluid. I am sure that this was the cause of the mishap in my first case. Right or wrong I have discarded the use of an irrigating bottle and compressed air and have substituted the use of a Pitkin Sana Lok Syringe. In using this syringe great care is taken to see that all the air is emptied from the syringe and the connecting tube before any solution is injected into the antrum, furthermore the nurse who manipulates the syringe is trained to report the least bit of pressure felt while injecting the irrigating fluid.

Pinkerton feels that if any air is to be insufflated one should be very careful in the recent postsurgical case as the ends of the small blood vessels may still be open and predispose to an air embolism Again, why inject any air at all?

The following is a report of two cases of air embolism that have happened in my practice

Case 1 A. L a 25 year old Chinese male, was first seen on March 1, 1940, with the complaint of nasal obstruction, a purulent nasal discharge and rheumatic pains in the joints An otolaryngological examination revealed a large septal spur on the left side which was jammed up against the left middle meatus a polypoid degeneration of the posterior tip of the left inferior turbinate and pus in the left middle meatus and nasopharynx A submucous resection of the nasal septum was done on April 13 1940 Subsequent to this, he reported periodically for treatment and complained of a continued nasal discharge On May 21 1940 a lavage of the left antrum was done through the natural ostium During the lavage, it was noticed that air was also escaping from the irrigating bottle together with the nomal saline Suddenly the patient collapsed in the chair, had a carpopedal spasm followed by generalized clonic convulsions, the pulse was rapid but of good quality, and the respirations were jerky and irregular The pupils were small and reacted to light Between convulsive seizures, the patient appeared flaccid After an hour it was decided that this was more than the usual "fainting spell' and the patient was sent to the hospital in an ambulance While being carried down the steps on a stretcher, he had a severe convulsion dropped from the stretcher and landed head first on the concrete floor from a level of 12 feet suffering a laceration of his scalp in the region of the right occipitoparietal area

On admission to the hospital, the blood presure was 124/90, the temperature 102 4° F, rectally, the pulse 140/min and the respiration varied between 32 to 40/min R B C, 6,150 000 with 90 per cent hemoglobin, W B C, 21,400 with 90 per cent polys Urinalysis normal X ray of the skull was negative for a fracture

A neurosurgeon was called into consultation and his notes were as follows 'The patient is semiconscious and will respond to commands Lies with his eyes open, staring and expressionless Any attempt to move him causes him to kick violently with his right leg Respirations are quiet and regular Occasionally he spits out saliva forcefully, swallows, but keeps mouth tightly closed Fundi normal Pupils widely dilated and fixed to light There is a constant oscillating conjugate movement of the eyes upward and to the left, a type of nystagmoid movements with the quick component toward the midline This movement is at times a wide excursion and at other times a narrow one Corneal reflexes are present with the left side more active than the right He moves all extremities except the right arm which is moved reluctantly The right leg, however, is almost constantly kicking, elicited by movement of the arms and legs The movement of the extremities cause extreme extensor rigidity arms extended and pronated, fingers over thumbs No flaccidity The biceps, triceps, radical reflexes, knee jerks and ankle clonus are slightly hyperactive The plantar reflexes are diminished and the abdominal reflexes are absent *Impression* 1 Possible extradural hemorrhage from skull fracture 2 Intracortical hemorrhage—spontaneous"

A spinal puncture revealed normal pressure, the fluid was a pinkish yellow with floating red cells Microscopic examination showed five leucocytes per c mm and numerous blood cells

The patient continued comatose in fact, the coma deepened and he had two projectile vomiting spells. He had typical Jacksonian convulsions starting from the left fingers and wrist and gradually extending to the left side of the body During these seizures the eyes deviated to the right. After six of these convulsive seizures which occurred at short intervals, it was decided that there probably was an irritative focus on the left side probably in the motor areas The convulsions were not controlled by sodium luminal, so one-half gr of morphine sulphate was given subcutaneously Within an hour the respirations became depressed he ceased breathing for several minutes but commenced to breathe again after the administration of artificial respiration He was rushed to surgery during which time artificial respirations had to be continued in order to keep him alive A right temporoparietal craniotomy was done The brain was found to be under great tension and herniated considerably On aspiration of the fluid from the frontal horn of the left ventricle the fluid appeared to be under great pressure After aspiration the patient s respiration improved and he breathed 12 to 14 times per minute by his own effort. No evidence of any cortical hemorrhage was seen. A large subtemporal decompression was made in the lower portion of the bone flap He was given several blood transfusions and was returned to the ward in fairly good condition.

Postoperatively his respirations were free and easy and his temperature, though lower than at surgery continued at 102° and 103° F His condition was considered satisfactory but on the second postoperaive day he suddenly became cyanotic and expired in spite of all treatments.

An autopsy revealed cerebral congestion and edema cerebral extravascular hemorrhage of the left temporal lobe and the left motor cortex pulmonary congestion diffuse toxic hepatitis cloudy swelling of the kidneys and subendocardial hemorrhage.

Case 2 P L., a 40-year-old Chinese male was seen at periodic intervals for a right maxillary sinusitis. He was in good health except for the recurrent attacks of sinusitis. He had had a previous submucous resection of the nasal septum and numerous lavages of the antrum both through the inferior meatus and through the natural ostium without incident. On July 20 1946 a lavage of the right antrum was done through the natural ostium and air was insufflated to dry out the antrum Suddenly the patient gave a grunt, stiffened up and fell over backward in the chair unconscious and stopped breathing He was immediately placed on the floor artificial respiration was started and 1 cc. of adrenalin chloride 1 1,000 was injected intravenously After his respiration returned it was sterterous and irregular and there was much foaming of the mouth There was an alternating spasm and relaxation of the muscles of his extremities and a severe trismus. The pulse was rapid but of good quality He was cold and clammy with a profuse perspiration. The pupils were small and reacted to light but there was a conjugate deviation to the left. The patient was hospitalized and a neurosurgeon was called into consultation

On admission to the hospital the temperature was 98.2° F the blood pressure 130/80 pulse 120 and the respiration varied between 20 to 30 per minute He was given oxygen through a nasal catheter the foot of the bed was elevated penicillin was given intramuscularly and caffeine sodium benzoate when necessary He continued in coma and his temperature rose to 103° F The convulsions continued and there was a marked extensor spasm of all four extremities intermittently with a clocklike decerebrate rigidity Between attacks of spasms the extremi ties were flaccid and there was a bilateral ankle clonus The pupils became dilated but reacted to light, and there was a continued conjugate deviation to the left The patient's condition became worse with a gradual climbing of the temperature, a more irregular respiration until there was a Cheyne Stokes respiration The stomach became markedly distended, and a Wagenstein suction bottle was used to attempt to control the gastric dilation The tracheobronchial tree began rapidly to fill up with mucus, so an attempt was made to aspirate the trachea. As this was being done, the patient developed a reverse peristalsis and vomited up an enormous quantity of dirty black material and ceased breathing

At autopsy, there was edema of all the lobes of the lungs and patchy areas of consolidation of both lower lobes The trachea and primary bronchi contained a small amount of clotted blood The heart appeared normal but was not opened under water The stomach was markedly dilated and contained much dark, thready material which had the appearance of old blood The rest of the gastrointestinal tract was normal The left maxillary sinus revealed a purulent infection and a small polyp Sections through the brain showed purplish gray discolored areas at the level of the optic chasm, the anterior end of the third ventricle, at the tip of the globus pallida on the left side and the lower part of the midpons. The area in the midpons was 1 cm in diameter and appeared to encroach upon the pyrimidal tract. There was no gross lesion to be seen, such as hemorrhages, softening or massive air embolism

Comment In the first case, the picture was complicated by the unfortunate fall, however, the clinical picture before the fall was typical and characteristic of an air embolism The findings at autopsy were complicated and were overshadowed by the cerebral edema subsequent to the injury and the surgical procedure

In the second case, the symptoms also were characteristic and typical of an air embolism, although no air embolism was found At autopsy, however, the heart and pulmonary artery were not opened under water

SUMMARY

1 The most serious and alarming complication of a lavage of the maxillary sinus is an air embolism

2 A review of the literature is presented Fifty-eight cases of air embolism have been collected Of these 58 cases, there were 23 deaths with a resulting mortality of 39 5 per cent

3 The signs and symptoms of air embolism are characteristic and once seen are unforgettable

4 Two cases of air embolism following the lavage of the antrum and the insufflation of air are presented

CONCLUSIONS

1 The inflation of air following a lavage of the maxillary sinus is not only unnecessary but exceedingly dangerous

2 The only way to prevent this complication is to avoid the insufflation of air into the antrum

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BRONCHIAL ADENOMA.*

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Sixty nine years ago Mueller[1] reported the first bronchial adenoma. At necropsy on a woman who died from suppurative lung disease of eight years' duration, he found a pedunculated adenoma partially occluding the left main bronchus.

In 1927 Heine[2] found a polypoid tumor the size of a grape in the right middle lobe bronchus of a 45 year-old woman. It had given rise to no symptoms, although bronchiectasis was noted distally to the tumor.

A year later, Reisner[3] reported the death of a woman from empyema and bronchial obstruction. This obstruction was due to an adenoma. In 46 years only three cases of bronchial adenoma were reported, and all were diagnosed at necropsy.

Since the last report in 1928 many excellent articles relating to the various aspects of bronchial adenomas have appeared. Prior to 1944 were the reports of Womack and Graham,[4] Brun and Goldman,[5] Foster-Carter,[6] Goldman and Stephens,[7] Anderson,[8] Adams *et al.*,[25] Laff and Neubuerger,[9] and Riordan and Richards.[10] Since 1944 are those of Jackson, Konzelmann and Norris,[11] Nager,[12] Graham and Womack,[13] Chamberlain and Gordon,[14] Harris,[15] Clerf,[16] Souders and Kingsley,[17] Moersch and McDonald,[18] Maier and Fischer,[19] McCart,[21] Holley,[23] and Huizinga and Iwema.[27] In all, about 300 cases have been tabulated, nearly all of which were diagnosed antemortem.

Almost all early writers stressed the benignancy of these growths although Kramer[20] in 1980 suggested that local ma

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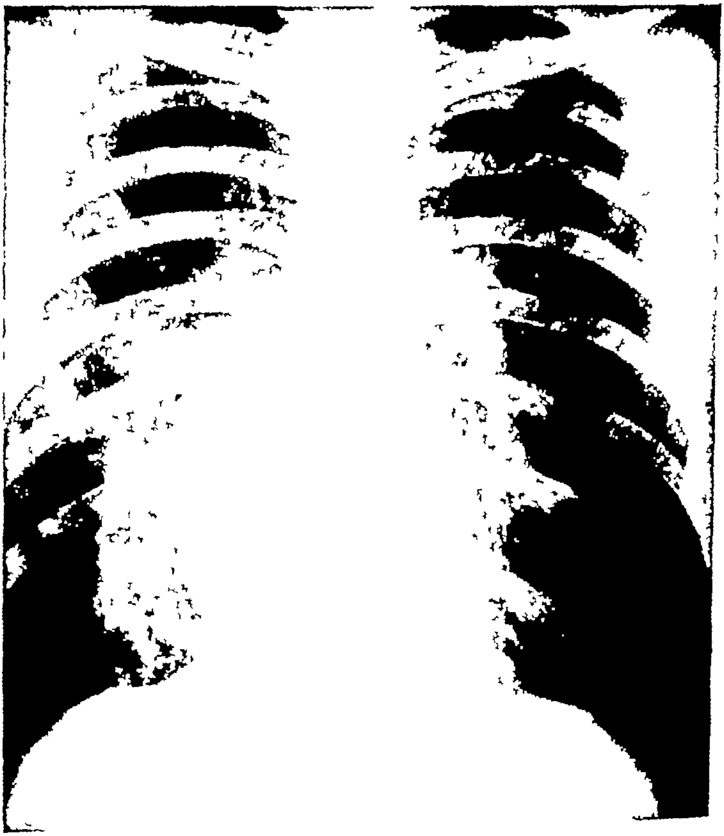
lignancy might occur It would seem that adequate evidence is now available to merit a definite conclusion relative to the classification and treatment of this interesting neoplasm

It has been stated that about 8 per cent of all primary bronchial tumors are adenomas Clerf reported an incidence of



Case 1 Roentgenogram showing collapse of right lower and middle lobes which was secondary to adenoma in right main stem bronchus

12 per cent of 278 neoplasms diagnosed bronchoscopically Of 217 histologically proven primary lung tumors diagnosed at the Lahey Clinic since 1930, the incidence was 6 9 per cent, or only 15 adenomas They reported nine of the cases within

struction with apparently equal success Sheehan and Swanker[89] grind up autogenous bone, mix it with fibrin foam and thrombin until a cohesive mass is obtained and then insert it into a prepared bed and apply a pressure dressing This is excellent for molding into shape and there is a quick "take"

Various inert substances have been tried for reconstruction A prefabricated acrylic implant employed by Jeremiah[90] to correct a severe malar deformity has remained fixed and undisturbed for three and one-half years Kleitsch[91] has reconstructed a malar defect with vitallium Marked fibrous reaction around tantalum mesh and wire has been found by Koontz and Kimberly[92] but the tissue has remained soft and pliable, nevertheless

An operative correction of recessed malar-maxillary component in a case of oxycephaly by means of extensive osteotomy is reported by Gillies and Harrison [93]

By immediately skin grafting the interior of the defect following *resection* of the maxilla, Ward and Edgerton[94] avoid prolonged drainage, discomfort, and secondary hemorrhages due to infection By means of a "hollow ball" type of oral prosthesis a flat deformity of the face with eyelid edema, ptosis and diplopia can be corrected

Lateral facial clefts, although relatively uncommon, are reported by Blackfield and Wilde[95] (five cases), who discuss the etiology, and by Potter[96] (one case), who outlines the operative procedures required for repair

MANDIBLE

For reducing fractured mandibles in unusually complicated cases, Kleitsch and Smith[97] find the use of modified Sherman bone plates a simple and rapid technique that is immediate and extremely accurate since it is done under direct vision The use of adequate amounts of penicillin (600,000 units daily) is an integral part of the procedure

Although ramisection of the lower jaw is an established procedure for advancing the lower jaw in micrognathia and the past three years, compared with six in the previous 15 years. This may indicate a more definite agreement on the histology

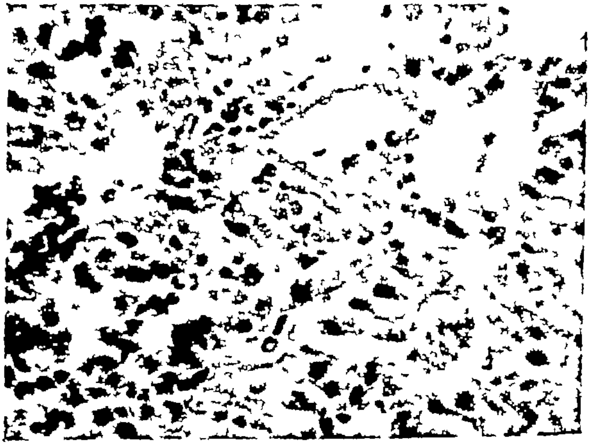
Bronchial adenomas are more prevalent in the third and fourth decades They are somewhat more prevalent in females

Case 1. Roentgenogram taken two years after right pneumonectomy for adenoma.

The tumor is usually located in the larger bronchi, hence readily visualized bronchoscopically, however, Maier and Fischer[19] have reported adenomas arising in small bronchi and not visible bronchoscopically

One of the chief characteristics of the symptomatology of these growths is chronicity Bronchial adenoma is a slow-growing tumor, hence has prolonged signs Cough, wheeze and blood-tinged sputum may be the only symptoms for many months or even years, however, recurring bouts of fever and chest discomfort frequently diagnosed as atypical pneumonia by the clinicians and unresolved pneumonia by the Roentgenologists should arouse one's suspicion of an endobronchial new growth and be followed by a request for bronchoscopic examination Further variations of symptoms depend on the endo- and peribronchial extension of the growth and the resulting mechanical conditions

Two new cases are herein reported to further emphasize the protean nature the symptoms may present These two cases had similar operative findings but very dissimilar preoperative histories



Case 1 Photomicrograph showing glandular formation with incomplete lumen

Case 1 A young man, aged 20, had six endoscopic treatments in five years of an adenoma in the right main bronchus The tumor eventually became obstructive,atelectasis developed and operation was necessary At operation extensive hilar spread was found and a pneumonectomy was indicated Only four years have elapsed but he is in excellent physical condition He is an instructor in a college of music, sings in the glee club and plays a wind instrument in the orchestra Diagnosis was bronchial adenoma, carcinoid type

Case 2 Mrs H., age 32 no chest symptoms until six months before surgical treatment was instituted. Within one month she had two bouts of chills fever and lower right chest discomfort. The diagnosis was atypical pneumonia. Roentgen diagnosis was unresolved pneumonia with question of a small area of segmental atelectasis of the right lower lobe At bronchoscopy a small reddish new growth was seen in the bronchus of the posterior basal segment on the right side Pathological diagnosis was bronchial adenoma, cylindroma type Surgery revealed extensive peribronchial spread upward along the main stem necessitating removal of the lower and middle lobes The patient is well and asymptomatic after three years.

Case 2. Photomicrograph shows cylindroma type of cells with amyloid stroma.

It is interesting to note the various names used in the past to describe these tumors

1931 — Geipel — Basal Cell Cancer
1932 — Wessler and Rabin — Benign Bronchial Adenoma.
1935 — Kiernan — Carcinoid
1935 — Moersch and Bowing — Adenocarcinoma.
1936 — Clerf and Crawford — Benign Glandular Tumor
1937 — Zamora and Schuster — Vascular Adenoma
1937 — Welt and Weinstein — Endothelioma.
1937 — Hamperl — Cylindroma and Carcinoid.
1938 — Womack and Graham — Mixed Tumor of the Lung

1940 — Achsner — Reserve Cell Tumor

1940 — Goldman — Polypoid Bronchial Tumor

The type of cell is essentially the same in all bronchial adenomas, but there are distinct variations in the arrangement of cells which enable the tumors to be classified into two histological groups

1 Consists of tubular and glandular alveoli

2 Atypical structure and less degree of glandular formation, together with solid acini and irregular masses of cells Mitoses are seldom seen These variations in structure have caused confusion in the past and failure to recognize them has falsified diagnosis

The most commonly used terms are Carcinoid and Cylindroma or Mixed Tumor A large majority now reported are called Carcinoids Pearson and Fitzgerald[22] state that all carcinoid tumors should be considered malignant Argentaffine granules have been definitely demonstrated in only one bronchial adenoma (Holley[23]) This would indicate these bronchial tumors are not histologically identical with the carcinoids of the alimentary tract There is a striking histologic similarity between bronchial carcinoids and the islet cell tumors of the pancreas[9] Boyd[26] also noted a likeness between pancreatic islet cell tumors and carcinoids of the appendix

According to Ewing[24] the term cylindroma may be used to designate any tumor in which the stroma appears in the form of elongated, twisted, thickened cords of hyaline substance The term should be used only as descriptive and not implying any fundamental relation to the cylindromatous type of basal cell carcinoma

The mixed tumor classification as suggested by Graham and Womack[13] is further supported by Holley[23] in his report of 39 cases of bronchial adenomas Thirty-four were classed as carcinoid and five as mixed tumor, however, to add to the confusion, he states that the stroma in these five cases was not of the myxomatous, osteoid or cartilaginous type usually associated with mixed tumors. To this extent the term mixed tumor is a misnomer

The widest divergence of opinion occurs concerning these so-called mixed tumors or cylindromas They have been considered as a bronchial tumor apart from the adenoma They have a very close resemblance to the mixed tumor of the salivary glands and to basal cell carcinomas of the skin Ewing[24] states that a marked similarity also frequently occurs between mixed tumors of the salivary glands and basal cell skin carcinomas.

Obviously the exact classification of these bronchial tumors is not yet determined. The relationship of these adenomas and alimentary carcinoids, pancreatic islet cell tumors, basal cell carcinomas of the skin and certain tumors of the salivary glands remains to be explained

The malignant potentialities of bronchial adenomas offer an important problem There has been a marked lack of agreement on this point, hence no uniformity of therapy Such authorities as Foster Carter[6] and Clerf[16] state that metastases do not occur and doubt if the tumors ever become malignant. Recently there have been several unequivocal reports of metastases. Anderson[8] reported metastasis to the liver Laff and Neubuerger[9] reported an adenoma with cylindromatous features which metastasized to the opposite lung

Adams *et al.*[25] presented five malignant bronchial adenomas. Moersch and McDonald[18] also reported five cases of definitely proved metastases They noted that metastasis to the liver is followed by rapid development of hepatic insufficiency and death. Holley[23] reports two metastases to hilar lymph nodes and one to the liver Metastases have appeared in the liver, bone, thyroid gland, skin contralateral lung and regional lymph nodes

SUMMARY AND CONCLUSIONS

Bronchial adenoma is a potentially malignant tumor The malignancy is low grade.

Most of the tumors occur in the larger bronchi Mucous glands are present in bronchi 2 mm in diameter, hence adenomas may occur in these smaller branches and not be visible bronchoscopically

The tumors usually have an intact mucosa, which explains why cytologic study of bronchial secretions often gives negative results

Exact histological classification has not been determined Carcinoid and cylindroma (mixed tumor) are now the commonly used terms

About 90 per cent of the cases can be diagnosed bronchoscopically, however, no one has presented histologic criteria by which, on biopsy, it can be predicted how much of the tumor is within the bronchial lumen or to what extent invasion or distal spread has occurred

In suitable cases the most satisfactory results are obtained by surgical extirpation of the lesion It may require bronchotomy, lobectomy or pneumonectomy Patients of advanced years and those with the tumor at the carina may have to be treated endoscopically A definitely pedunculated tumor may be removed by bronchoscopic means but the "iceberg" nature of these neoplasms must always be considered What is seen may be only a small portion of a peribronchial involvement Body section Roentgenography may be of valuable assistance

Patients treated endoscopically must be re-examined repeatedly because of the tendency to recurrence Severe hemorrhage may follow bronchoscopic removal and stenosis follow repeated coagulations

The exact rôle of deep Roentgen therapy is not determined

Even though many of these tumors do not fulfill our commonly accepted criteria for malignancy, their conduct is of such a malignant nature that total extirpation is the best form of treatment

Two cases are reported which demonstrate this type of conduct one of five years' duration and one of less than one year

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A NEW DESIGN FOR A RONGEUR TO BE USED IN LOWERING THE BONY SEPTUM *

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Philadelphia, Pa.

The removal of the nasal hump is one of the successes of plastic surgery which is frequently practiced, and the technique of this operation is familiar to all plastic surgeons[1] The intranasal incision is made, and the overlying skin of the region is undermined, followed by elevating the periosteum over the parts to be removed The excess tissue forming the hump is removed by cutting completely through at the desired level. The maxillary processes are fractured or separated by use of a saw in order to allow their closer approximation over the bridge, to narrow the nose sufficiently

When this last step is carried out, there is no need for recourse to the rules of geometry, to realize that pressing the maxillary processes toward the median line changes their relation to the perpendicular plate of the ethmoid, which forms the bony septum The result is that the upper border of the septum forms a sharp ridge along the nasal dorsum in this region. The final result is that a dorsal line is created, which is covered by only a thin layer of skin This condition lends itself easily to injury, by its tendency to act as a cutting edge Thus the skin may be cut through by the bony ridge leading to scar formation and more or less disfigurement

Kazanjian[2] has devised a rongeur with which he removes the entire hump, without the use of the saw In the hands of the writer this method has not proved so efficient as the customary one, in which the hump is excised by using the saw After the removal of the bony fragment, the remaining bony septum has usually been lowered by means of a rasp

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or a common rongeur The use of these instruments often leaves a rough, bony edge to form the dorsal line over the bridge

To avoid this outcome of the operation, the writer has prepared a rongeur, with which the perpendicular plate can be lowered evenly and smoothly

This instrument (see Fig 1) is made of stainless steel, and is seven and one-eighth inches (20 5 cm) in length The

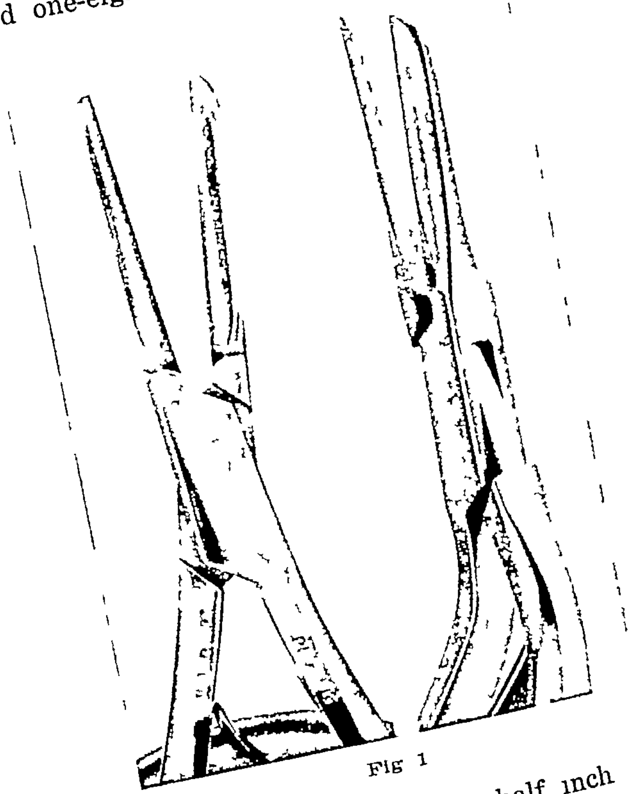


Fig 1

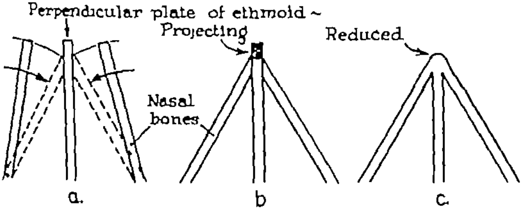
measurements at the hinge are one-half inch (1 2 cm) by five-sixteenth inch (1 0 cm) The blades are two inches (5 0 cm) in length They are beveled and are relatively thin To allow for reaching the bony septum, they are canted to form an angle of 90 degrees between their upper surfaces The for recessing it in prognathism, Brown, Fryer and Templeton[98] have recognized its potentialities in treating some late deformities in patients with cleft lips and palates who show such disproportion as to appear prognathic, and who have occlusions that are not adequate for mastication When these patients are too old or otherwise not suited for orthodontic expansion of the upper arch, then the mandible can be recessed to proper proportion with the upper jaw so that an external balance of appearance is obtained

Recession of the lower jaw for prognathism may occasionally be complicated by the lack of space for a large tongue *so that there are undesirable effects* on breathing or swallowing Edgerton[99] illustrates a case where previous elliptical excision from the dorsum of the tongue is done to avoid such a complication This type of size reduction is chosen because of its symmetry the minimal disturbance of muscle attachments, the loss of few taste buds and the absence of reduction in length

A two-stage procedure for advancement of the lower jaw in *extreme mandibular retrusion is recommended by* Edgerton[100] At the first stage he divides the shortened body through an intraoral incision and applies continuous elastic traction to the symphysis region by means of a head cap apparatus. Three weeks later at the second operation iliac bone grafts are placed between the bone ends through an external incision, dental splints to both jaws having been previously applied It is thought the end-result is thus improved A type of continuous elastic traction has also proved useful *for severe micrognathia in infants*

Kiehn and Glover[101] report 52 cases of autogenous bone grafts to mandibles for gunshot wounds with only one nonunion Satisfactory reconstruction is best accomplished by allowing complete healing before grafting having adequate tissue for early vascularization, and adequate fixation until bony union occurs Mandibular fragments should be retained in their normal position with intramedullary wires until the time of grafting handles (shanks) are angulated to an obtuse degree, just behind the hinge, and are cross hatched to provide a firm grip (see Fig 2)

The special value of this instrument is that after the hump has been removed, the blades can be fitted between the cut



Fig

edges of the maxillary processes, to lie on either side of the bony septum, and the necessary amount of tissue can be cut from the septum accurately and easily The anterior maxillary processes can then be pressed toward the median line, and the final presence of a roughened prominent dorsal ridge is avoided.

The writer has found that the use of this rongeur offers a particular advantage for narrowing the bridge in the operation for removal of a nasal hump

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Control of remaining jaw fragments after partial mandibular resection with loss of soft tissue and oral mucosa has been achieved by Edgerton, Ward and Sikes[102] by combining immediate replacement of soft tissue by graft or flap together with internal metallic fixation In place of the latter, intraoral fixation by prosthesis may be used if both mandibular fragments contain teeth

Grocott[103] discusses a case in which loss of lower lip and symphysis of the mandible had been treated originally with poor fixation which resulted in the fragments drifting together Reconstruction required an acromiopectoral flap and an ingenious placement of bone grafts Castro-O'Connor and Bianchi[104] report a case in which following mandibular resection for adamantinoma, a bone graft was done immediately and the condyle removed from the specimen was attached to the graft and replaced in the glenoid fossa A case of median cleft of the lower lip and mandible is recorded by Davis[105]

From the many groups of cases with temporomandibular joint pathology there can be separated one group with chronic capsular shortening These patients have trismus and pain on opening the jaw and with side to side movements Hynes[106] believes they should be treated by manipulation under anesthesia

TONGUE

Douglas'[107] operation for micrognathia, a surgical fusion of tongue and lip, is shown from the reports of various plastic surgeons to have lowered the mortality rate in these infants Apparently the condition is more common than is generally realized

Conley[108] has grafted the dorsum of a tongue using a semisoft metal plate placed over a modelled foam rubber sponge on top of the skin graft This is anchored by circumferential wires about the mandible and adequate immobilization achieved A repair of a partial traumatic amputation of the tongue is reported by Ulloa[109]

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Basic Sciences in Otolaryngology
September through June

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*Our subscribers are asked to send us information on other institutions giving such courses

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NUTRITION AND RELATED PROBLEMS

ISAAC H JONES, M D, Los Angeles,
EUGENE R LEWIS, M D, Los Angeles,
and
HAROLD S MUCKLESTON, M D, Pomona, Calif

Two decades ago came the great change in Otolaryngology Practice and interest and the literature had largely featured surgery Then came the sulfa drugs and then the antibiotics—and now our specialty is more in the medical than in the surgical field Hilger,[1] however, considers that our opportunity has been broadened and that the prophets of doom have not spelled the end of otolaryngology He feels that its scope is now enlarged by a closer integration of our field with general medicine — that the otolaryngologist has become more of a doctor and less a narrow and isolated specialist

Interest in nutrition is a symbol of this trend Likewise studies of the endocrines, autonomic influence, stress and allergy

To some nutrition simply means food, if, however, it is defined as the sum of all processes by which the body is nourished, or as the sum total of metabolic processes, both anabolic and catabolic, which result in the health or disease of tissues, or simply as 'what accounts for the health of tissue good or bad' — nutrition might actually be considered to include these other related subjects At any rate nutrition endocrines autonomic influence, stress and allergy are all

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interwoven inextricably in clinical practice It seems to us that they not only overlap but often interlock — one dependent on the other The understanding of one is certainly not clear without an understanding of the others Each of these subjects is elaborately presented in the literature, *separately,* but one wonders if each might not be considered as a finger and all five might not be considered together, as the thumb and fingers of a hand Into each one's practice comes a hint of this interrelationship and also the desire to master it It is a consummation devoutly to be wished — although with such a vision comes the arresting thought that "if one does not aim beyond the stars he will not reach the stars"

Of all the problems in medicine is there no other that belongs with these "five fingers"? It would seem that the others, such as infection, neoplasm, trauma, heredity and congenital abnormality are not directly related to nutrition but are, so to speak, "on the other hand"

We find this idea helpful, not only with a patient whose symptoms have no obvious cause but particularly with those whose history and findings offer no clue whatever We mention the five subjects and see if one or more of them may lead to something suggestive At least it gives an approach to a problem, and in the discussion of these points the patient may reveal pertinent facts For example, a woman has been greatly distressed, day after day for many weeks, by a feeling that she is about to pitch forward — never in any other direction Vestibular findings normal in every detail Cochleas normal We then ask about nutrition and find that she has been studied at one of our best metabolic clinics for two weeks, with recommendation for increased protein So that seems to be covered Endocrines Apparently negative She had an uneventful menopause ten years ago without sequelae Autonomic influence or allergy Nothing in history or present state suggests either Stress For over a year she had worried greatly over her husband's incapacity to work — cause undetermined This offered a possible lead toward an explanation and relief and the idea was discussed with the patient. Following the husband's recovery the symptom promptly faded away

Having offered some definitions of nutrition we will now consider some recently available data concerning the other four problems in an attempt to *correlate* them with nutrition as well as with each other

ENDOCRINES

As Mahoney[2] expresses it the relation between the endocrines and otolaryngology could have been more clearly described several hundred years ago than today The pituitary was then accepted as the source of nasal secretion and the thyroid as the source of the mucus of the larynx and trachea In the words of de Schweinitz[3] "it was true then — because they believed it." Mahoney wisely regards endocrinology as a new field in physiology — even though he outlines the vast amount that is already known (1) The anterior pituitary with its own five known hormones — all proteins (2) The glands stimulated by the anterior pituitary — the thyroid adrenal cortex, ovary and testis (3) The posterior pituitary, pancreas, parathyroids adrenal medulla and placenta. Like vitamins, their products are indispensable in nutrition They derive from food their remarkable active principles which then in turn play such a large part in regulating the utilization of the food

When vitamins first came upon the stage they held the center for years, their importance is in no way lessened now that they have found their place. At the moment it is the adrenal cortex that has gained great prominence and like the vitamins, it is destined to maintain it. The unfolding story of the adrenal glands is presented by Mulholland[4] For nearly 100 years it has been known that these organs, though so small, are essential to life The modern story of the adrenal cortex began in 1930 when extracts became available for human use. The gland is concerned with the ability to exist in an environment which changes, its medulla provides epinephrin for sudden emergencies and its cortex provides the

many hormones for more profound environmental changes These hormones from the cortex affect the electrolyte balance and the metabolism of protein, carbohydrate and fat They have widespread effects in almost every metabolic process Hyperactivity of the adrenal cortex causes marked diminution of eosinophils The rate of their disappearance is fairly uniform, if 25 mg of ACTH is given the fall is maximal in 4 hours This is the basis of the Thorn test With a competent and responding adrenal cortex the fall is from 50-100 per cent of circulating eosinophils Sufficient evidence in the human being has accumulated to establish that the pituitary-adrenal cortex system is a protective buffer against environmental change

AUTONOMIC FUNCTION

Although he does not discriminate between functional variations and dysfunction Hilger[1] presents an ingenious interpretation The very term "vasomotor", so often applied to the nose or internal ear, implies a motor mechanism, this is neural and centers in the hypothalamus which controls the autonomic functions of all parts of the body It is influenced by the psychomotor areas in the frontal cortex and reflexly by body surface receptors There is evidence that the pituitary is influenced — if not controlled — by the hypothalamus It operates through the pituitary and hence through the blood, it also acts directly through neural pathways, to exercise direct cellular control in the peripheral tissues The sole purpose of the autonomic nervous system is to contribute to man's adaptation to environment Hilger's concept is that disordered function results when the hypothalamus is unequal to the task The environmental influences are, in the order of their importance, emotional, physical, inhalant and ingestant There first occurs arteriolar spasm, then ischemia, cell injuries and transudate It becomes increasingly apparent that mucoid middle ears may result less from bacteria than from tissue reactions In the bronchial tree neuromuscular activity may be added — asthma Neurovascular change can affect the internal ear — cochlear or vestibular Neural tissues tolerate ischemia poorly and lose function rapidly Although

Hilger may seem to overemphasize autonomic dysfunction to the exclusion of other important factors, his concepts are pertinent and stimulating In adapting his concept to the internal ear he[5] regards autonomic dysfunction as the prime factor in its many disturbances and endocrine imbalance as a frequent additional factor He considers that the clinical picture varies with the neural segment involved and the degree of involvement, that chronic progression suggests minute neurovascular changes whereas extensive angiospasm accounts for complete loss of cochlear and vestibular function He describes in detail the various medications which he used, the outcome in fourteen cases and his interpretations

Many cochlear disturbances suggest to Cook[6] a mild hydrops which he terms a "water-logged" ear The hearing fluctuates at times the ear feels clogged up and sounds seem discordant or too loud He finds this concept reasonable because in some the symptoms are transitory while in others they progress to deafness A water logged ear seems vulnerable to loud noises, he calls such persons "noise-susceptible" The majority of his patients were using salt in excess so he gave low sodium and high potassium intake for one month, if there was no response he added nicotinic acid as a vasodilator

STRESS

All who study the remarkable and elaborate work of Selye[7] may well be grateful to Guillemin[8] for presenting its main points. When any living organism is placed under abnormal conditions which disturb its vital equilibrium — in other words, under *stress* — the organism reacts against them The phenomena which result are termed the 'Alarm Reaction" It is a call to arms of the defenses of the body These reactions which constitute the resulting shock are practically identical regardless of the nature of the insult among other results, the experimental animal almost always develops gastric ulcer In the countershock which ensues epinephrin is immediately thrown out by the adrenal medulla then follows ACTH which causes the adrenal cortex to send out hormones of the cortisone type. This provides the organism with a much more prolonged defense than that from the epinephrin Also released are other endocrine substances not yet fully understood Now, if the stress ceases this fight ends and endocrine hyperactivity subsides On the contrary, if further stress is applied then the body must continue to defend itself against this abnormal condition to which it tries to *adapt* Soon the organism reaches what is called the *stage of resistance*, in which it has developed an *optimal adaptation* Now, if stress continues for several weeks, or even for several days if it is very strong, the defense mechanism collapses and the animal dies These three stages — alarm reaction, resistance and exhaustion — are termed the *general adaptation syndrome*

Ménière's Syndrome is generally regarded as due to hydrops of the internal ear The observations of Fowler, Jr and Zeckel[9] led them to the psyche as the main factor, the stress is occasionally from physical fatigue, illness or surgical operation, but is usually emotional in origin They studied 23 patients with paroxysmal attacks of vertigo, nausea and vomiting, in addition to tinnitus and hearing loss From the time of Menière's original study in 1861 the lesion has been suspected to be vascular The authors studied the vessels of the conjunctiva and noted clumping of red cells in the small vessels, before and after attacks of Menière's Syndrome, extravasations and occasional small hemorrhages were observed By analogy, such "sludged" blood in the internal ear could account for the symptoms and, if it lasted for any length of time, for endolymphatic hydrops

ALLERGY

It is refreshing to have Semenov[10] recall that not long ago — and yet the time seems distant — all rhinitis and sinusitis was attributed to infection, words such as "histamine" and "allergy" were known only to research workers, and Sir William Osler called syphilis "the great imitator" As matters now stand, the great imitator seems to be allergy In any consideration of the pathology of the nose and sinuses we must reckon with allergy, not only its typical form such

as hay fever but also its masked form as in "collagen disease" Semenov notes that in some of these obscure conditions infection is the precipitating factor, but that the resulting storm rotates in allergy and often runs a relentless up and down course, which we fought for years under what he terms the "tattered and torn banner" of focal infection

The hope that hearing loss may be prevented or restored by judicious antiallergic treatment is offered by Jones and co-workers.[11] For years many have regarded allergy as one of the causes of impaired hearing As to the middle ear, the writers have observed permanent restoration of hearing by eliminating a common underlying cause of recurring nasal sinuitis, allergy Recently interest has centered upon the theory that Ménière's Syndrome is vasomotor in nature, due to autonomic dysfunction or allergy Helpful in treatment are elimination of contacts, a selection of foods which have minimal allergen content with maximal protein and complete nutritional values, and aid in the physical and mental rehabilitation of the patient.

Also in the experience of Shambaugh Jr [12] allergy may be a factor in deafness of both middle and internal ear types The tube and middle ear are lined with the same respiratory mucosa that readily elaborates antibodies against foreign proteins and often develops clinical allergies Allergy of the internal ear seems less easy to explain until we reflect that the endolymphatic tissues are derived from the ectoderm which also readily becomes sensitive to foreign proteins As in nasal allergy, allergy of the middle or internal ear is suspected when there are other allergic symptoms, when an aural discharge is very mucoid and resistant to treatment and when eosinophils are found in the secretion

The line of thinking and recent emphasis on stress autonomic influence and allergy has been applied by Phillips[13] even to multiple sclerosis He notes that many consider allergy as playing a major role in etiology and he regards the personal, emotional problem of the patient as perhaps the

most important factor He reasons that we are familiar with urticaria resulting from emotional and food allergy, having a common embryologic origin with the skin, it seems that tissue of the central nervous system may also respond with isolated areas of edema and pressure Degenerative changes may or may not result The cause of multiple sclerosis is unknown, but it does not occur in animals nor can it even be produced in animals The most common symptoms are double vision and paralysis of an extremity but not infrequently one notes vertigo, headache, tinnitus and hearing loss

Is there anything which favorably influences all types of allergic reaction? It seems to Rawlins[14] that from such a starting point it might be possible to develop a sound hypothesis of allergy Cortisone may be an answer His concept is that allergic edema occurs in the amorphous substance of subepithelial connective tissue This mesenchyme contains hyaluronic acid which in normal individuals is a firm gel The allergic reaction liberates many substances Histamine has been regarded as the most important but Rawlins considers that hyaluronidase is also of importance, liquefying the firm gel and making it edematous Cortisone affects this edema by neutralizing the hyaluronidase This hormone, then, is an antihyaluronidase factor, as are also the antihistaminic drugs In proposing this concept he does not overlook — in fact he emphasizes — the local autonomic dysfunction in allergy and the autonomic influence on the hormonal system

* * * *

ITEMS ON NUTRITION

Few of today's bits of news bear directly on ear, nose and throat practice but all have a direct bearing on ear, nose and throat problems

This is our eleventh editorial on nutrition Last year[15] we stressed the concepts of synthesis of vitamins within the body, and of antibiotics lessening this supply of vitamins as well as permitting yeasts and molds to flourish We also

FACIAL PARALYSIS

Grundt[110] treats VIIth nerve paralysis by using a portion of the *palmaris longus* tendon with its paratenon and a flap of temporalis muscle detached from the coronoid process The tendon moves freely on a sling arrangement which allows for adjustment in length The temporalis muscle attachment gives some mobility to the smile

The possibility of the development of neuromuscular junctions in cases of facial paralysis repaired by masseter muscle transplants has been suggested by Owens,[111] because a greater degree of animation was noted in patients so treated than in those having fascial strip implants In addition, movements have been noted in related groups of muscles located at some distance from the attachment of the transplanted muscle bundles

Sheehan[112] *has somewhat changed his previous technique* by using tantalum wire for facial palsy and is now using both braided tantalum wire and mesh, making one large loop along the nasolabial fold He feels he has improved the procedure and overcome previous objections and weaknesses. The mesh prevents the wire from cutting through the muscle bundles

Melkersson's syndrome as described by McGovern[113] is recognized by a triad of findings peripheral facial paralysis, chronic angioneurotic edema and lingua plicata. The paralysis is sudden and complete with recovery slow but without residual weakness. The palsy does not require plastic surgery but it is sometimes necessary to correct the long standing edema by surgical excision of redundant tissue in the face.

The extremely difficult problem of spastic facial palsy may be overcome according to Marino and Alurralde[114] by peripheral selective neutotomy Adequate exposure is made and terminal VIIth nerve branches isolated, the selection of fibres being controlled with electric excitation by a faradic current before sectioning It is important not to get an undue extension of flaccid paralysis

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It is refreshing to have Semenov[10] recall that not long ago — and yet the time seems distant — all rhinitis and sinusitis was attributed to infection, words such as "histamine" and "allergy" were known only to research workers, and Sir William Osler called syphilis "the great imitator" As matters *now stand, the great imitator* seems to be allergy In any consideration of the pathology of the nose and sinuses we must reckon with allergy, not only its typical form such

as hay fever but also its masked form as in "collagen disease" Semenov notes that in some of these obscure conditions infection is the precipitating factor, but that the resulting storm rotates in allergy and often runs a relentless up and down course, which we fought for years under what he terms the "tattered and torn banner" of focal infection

The hope that hearing loss may be prevented or restored by judicious antiallergic treatment is offered by Jones and co-workers[11] For years many have regarded allergy as one of the causes of impaired hearing As to the middle ear, the writers have observed permanent restoration of hearing by eliminating a common underlying cause of recurring nasal sinuitis, allergy Recently interest has centered upon the theory that Ménière s Syndrome is vasomotor in nature due to autonomic dysfunction or allergy Helpful in treatment are elimination of contacts, a selection of foods which have minimal allergen content with maximal protein and complete nutritional values, and aid in the physical and mental rehabilitation of the patient.

Also in the experience of Shambaugh Jr[12] allergy may be a factor in deafness, of both middle and internal ear types The tube and middle ear are lined with the same respiratory mucosa that readily elaborates antibodies against foreign proteins and often develops clinical allergies Allergy of the internal ear seems less easy to explain until we reflect that the endolymphatic tissues are derived from the ectoderm, which also readily becomes sensitive to foreign proteins As in nasal allergy allergy of the middle or internal ear is suspected when there are other allergic symptoms when an aural discharge is very mucoid and resistant to treatment and when eosinophils are found in the secretion

The line of thinking and recent emphasis on stress, autonomic influence and allergy has been applied by Phillips[13] even to multiple sclerosis He notes that many consider allergy as playing a major rôle in etiology and he regards the personal, emotional problem of the patient as perhaps the

most important factor He reasons that we are familiar with urticaria resulting from emotional and food allergy, having a common embryologic origin with the skin, it seems that tissue of the central nervous system may also respond with isolated areas of edema and pressure Degenerative changes may or may not result The cause of multiple sclerosis is unknown, but it does not occur in animals nor can it even be produced in animals The most common symptoms are double vision and paralysis of an extremity but not infrequently one notes vertigo, headache, tinnitus and hearing loss

Is there anything which favorably influences all types of allergic reaction? It seems to Rawlins[14] that from such a starting point it might be possible to develop a sound hypothesis of allergy Cortisone may be an answer His concept is that allergic edema occurs in the amorphous substance of subepithelial connective tissue This mesenchyme contains hyaluronic acid which in normal individuals is a firm gel The allergic reaction liberates many substances Histamine has been regarded as the most important but Rawlins considers that hyaluronidase is also of importance, liquefying the firm gel and making it edematous Cortisone affects this edema by neutralizing the hyaluronidase This hormone, then, is an antihyaluronidase factor, as are also the antihistaminic drugs In proposing this concept he does not overlook — in fact he emphasizes — the local autonomic dysfunction in allergy and the autonomic influence on the hormonal system

* * * *

ITEMS ON NUTRITION

Few of today's bits of news bear directly on ear, nose and throat practice but all have a direct bearing on ear, nose and throat problems

This is our eleventh editorial on nutrition Last year[15] we stressed the concepts of synthesis of vitamins within the body, and of antibiotics lessening this supply of vitamins as well as permitting yeasts and molds to flourish We also

stressed that the creation of vitamins by bacteria in the intestine is obviously of great importance in nutrition — and that anyone who prescribes sulfa drugs or antibiotics is deeply concerned with their action on these bacteria We said that the time was not yet when it could be stated that the sulfa drugs or antibiotics (1) lessen the supply of vitamins and (2) also permit yeasts and molds to flourish — but that there was a trend of opinion in that direction The evidence indicated that (1) physicians, especially otolaryngologists, should be watchful and aware of these two new "Cautions", (2) we should be more hesitant in giving antibiotics so freely, especially for trivial ailments and (3) it would seem advisable to give B Complex with the antibiotic.

Since that time, new evidence seems to confirm these suggestions which we made with some hesitation last year In a comprehensive survey Smith[16] calls attention to the complex balance which exists among microorganisms constituting the normal flora of the body This balance is disturbed by antibiotics, with resulting vitamin deficiencies or actual new infectious disease syndromes The importance of normal flora was not appreciated until it was disorganized by chemotherapy In the struggle among themselves bacteria and fungi were employing their own antibiotics as offensive weapons long before they were discovered by man. Most of the known antibiotics which kill bacteria are produced by fungi antibiotics derived from bacteria kill fungi but unfortunately they are toxic for man Following antibiotic therapy monilia are often found in serious infections of the mouth and pharynx vagina and lungs and fatal infections have occurred following invasion of internal organs Although some intestinal bacteria may be destroying vitamins, most of them are engaged in synthesizing K" and members of the B Complex group The amount of absorption has been questioned but it seems probable that some vitamins are absorbed from the colon Even a small supplement from this source may be of great importance

Monilial infections of the mouth, intestinal tract, bronchi lungs skin and endocardium continue to be reported following penicillin, aureomycin, chloramphenicol and terramycin therapy The Lederle Laboratory suggested to McVay and Sprunt[17] that esters of paraben might prevent development of monilia which sometimes follows antibiotic therapy The monilia flourish most frequently in the large bowel without serious consequence, however, deaths have occurred from moniliasis in other organs These esters have been employed in foods and drugs as preservatives for many years The methyl ester of paraben is effective against molds and the propyl ester against yeasts The investigation used two preparations, one of aureomycin alone, the other of aureomycin with the paraben esters Oral, vaginal and rectal studies were made on 186 patients The results indicated that esters of paraben are of value in preventing overgrowth of monilia following aureomycin therapy

We are reminded by Patton[18] that the chief causes of death and disability have always been violence, infection and degenerative disease It is probable that infection dates from those forgotten years when man began to lead a communal existence Against bacteria man has had little or no defense until a very short time ago, only within the last few centuries has any effort been made against them — beginning with quinine and the heavy metals The deliberate creation of our modern drugs is a far cry from the development of quinine In the 17th century Peruvian natives relieved a patient, sick of "intermittent fever", by infusions of a bark, and in honor of her husband, Count Chinchon, Viceroy of Peru, this bark came to be called "Cinchona" So its alkaloid, quinine, became the first "wonder drug" Later came vaccines and anti-sera, and the past twenty years have finally seen the direct attack upon bacteria by the sulfonamides and antibiotics

It is not too much to say at the present time that, for acute conditions, perhaps half of all medical and surgical patients receive antibiotics as part of their treatment Pulaski[10] lists seven as now commercially available In surgery they are useful before and after operation They are most effective in acute conditions characterized by cellulitis Failure is not necessarily the fault of the antibiotic but may be explained

SALIVARY GLAND

Brown, McDowell and Fryer[115] describe a direct operative approach to benign mixed tumors of anlage origin in the parotid gland A wide exposure of the parotid area by elevation of a large facial flap is used and direct removal of the tumor by extremely careful dissection to avoid VIIth nerve damage is done This is thought preferable to identifying routinely the main divisions of the nerve and their relation to the tumor by tracing a small branch picked up in the neck or face, an indirect procedure which often becomes a surgical exercise and is even more apt to damage the nerve The direct approach is possible because the facial nerve usually lies deep to the superficial lobe of the gland in which most benign tumors are found Moreover, if the tumors are considered to be of anlage origin, they are actually not derived from the gland and their relationship to it is merely incidental In the 75 patients with benign mixed tumors so treated there has been no paralysis of the facial nerve and no evidence of recurrence In patients with malignant lesions where there has been a sacrifice of the nerve, a method of elevation of the paralyzed side with even the possibility of developing some emotional expression is described This consists of using autogenous fascia lata loops connected to the temporal muscle (Vth nerve innervation)

Klopp and Winship,[116] on the other hand, think that a subtotal parotidectomy is the procedure of choice for mixed tumors because of the danger of incomplete removal with subsequent recurrence and because any early malignant change may be controlled by initial wide excision

Primary repair for laceration of the parotid duct has been handled with success by Sparkman,[117] which anastomoses the ends over a urethral catheter, closes the wound without drainage, immediately removes the catheter and allows food to be taken promptly Adjunct therapy of penicillin and mouth washes are given Surgical ligation of the duct is the method of choice where a persistent fistula exists Bornstein and Simon[118] advocate use of an indwelling dowel *in situ,*" "to describe the expressions of faith by pathologists that a given segment of epithelium has undergone the initial stage of an irreversible sequence which can end only in frank invasive carcinoma." He believed it was impossible to foretell when invasion would begin[63] Bowen's first case did not invade until after a period of 19 years, yet Schiller's case required only seven years before invasion Willis, writing of further studies on the origin of carcinoma of skin, also refers to Bowen's disease, and states that the so-called precancerous dermatosis is now considered to be genuine carcinoma *in situ.*[64] Brighton and Altmann speak of superficial squamous epithelioma of Bowenoid type in reporting cases of intraepithelial spreading carcinoma of the upper respiratory and alimentary tracts[9] In recent years the many favorable references to Bowen's work can only signify recognition of the importance of his early contribution to the study of preinvasive cancer

In 1932 Broders emphasized that above everything else the microscopist must consider the character of the epithelial cells in order to arrive at a correct diagnosis He said that the day is past when epithelium can be considered nonmalignant because it has not penetrated the basement membrane, or malignant just because it is not confined within the basement membrane. In the latter sense he referred to benign penetrating epithelium in benign granulomatous ulcers such as in tuberculosis syphilis and actinomycosis. He said "The diagnosis of carcinoma *in situ*, as of any carcinoma in general, is based chiefly on altered cellular characteristics in contradistinction to cellular situation' He described the nuclei of malignant cells, in contrast to those of normal cells, as having greater avidity for basophilic stains, as usually increased in size both actually and as related to the cytoplasm, as frequently irregular, not infrequently in a state of pathologic or atypical mitosis, and occasionally observed in groups in the form of tumor giant cells. He believed carcinoma *in situ* may assume any type squamous, basal or adenocarcinoma, it may occur in any location in which carcinoma arises, and may be of any degree of malignancy He stated that in a biopsy of carcinoma with infiltration, the diagnosis will be easy, but if carcinoma *in situ* alone appears, it is necessary to recognize the malignant cell characteristics because the failure to do so is an error of omission fraught with grave danger to the patient[10]

Great credit must be given to Papanicolaou for his studies of cytology He writes that the idea of staining exfoliated cells was not new because Pouchet studied vaginal cells a hundred years earlier and Hampelon stained sputum 60 years ago As we have related, Papanicolaou became discouraged at his inability to interest clinicians in his cytological method of cancer diagnosis by vaginal smears, and returned to his previous work, however, in 1937, he became associated with Dr Herbert Traut in the study of cancer once again Vaginal smears were made routine in practically all gynecological patients in the Women's Clinic of the New York Hospital In a monograph in 1943, Papanicolaou and Traut reported studies of vaginal smears of 3,014 adult women There were 127 cases of carcinoma of the cervix and 52 cases of the fundus The cytological diagnosis by the vaginal smear technique failed in 3 2 per cent of the cervical and in 9 3 per cent of fundus cases They expressed the hope that cytological studies of smears from the cervical canal would be more accurate Later Papanicolaou reported that endocervical and endometrial smears reduced the chance of overlooking carcinoma of the cervix and endometrium[65 66 68]

Since the monograph of 1943, Papanicolaou's work has been confirmed by a number of other gynecological investigators[66] Fremont-Smith asserts that his group from Harvard was the first to corroborate Papanicolaou's cytological studies They wrote that biopsy is the best method of diagnosis, that there is exfoliation of cells from every epithelial surface of the body into the surrounding medium, that the cytological diagnosis of malignant tumors can be made on any cancer involving the free surface of any part of the body, that Meigs has presented evidence proving cytology theoretically sound, statistically reliable and superior at least in certain respects to biopsy Meigs showed that identical cells could be obtained by securing smears of malignant tumors at operations or from smears of body fluids of the patient bearing the tumor The diagnostic error of one group of 220 patients having 46 proven cancers was as low as 2.2 per cent.[31] There have also been rather numerous articles describing modifications of Papanicolaou's technique, and setting forth criteria of malignant cell characteristics.[4, 31, 34, 40, 64]

The Papanicolaou technique depends upon immediate fixation of smears while still wet. Equal parts of absolute ethyl alcohol and ether is the preferred fixative. This method avoids the distortion that accompanies drying of cells[64] Staining technique accentuates nuclear detail, while maintaining cytoplasmic transparency Smears now are being made of any body secretion, or of centrifuged sediment of thin body fluids or washings of epithelial surfaces Sediment adheres to albumen covered slides, and fixation is carried out before drying can occur One advantage is technical simplicity, and Papanicolaou also points out that it is not very expensive or inconvenient to patients[64] There have been numerous reports of modifications of this technique,[3, 6, 14, 62, 72] although Hunter and Richardson maintain that the value of Papanicolaou's stain cannot be overemphasized.[40]

Papanicolaou affirmed that the diagnosis of cancer by cytological studies should be 'based on strong, substantiative evidence offered by sufficient pathognomonic cells" and not merely on a few cells He maintains that negative or inconclusive tests should be repeated Among the advantages that he has described are *1* its simplicity and inexpensiveness, *2* its reliability in hands of experienced cytologists, *3* that it permits early recognition of hidden or incipient neoplasms such as carcinoma *in situ* by exfoliation before the onset of ulceration *4* its suitability for a screening method on large numbers of patients, *5* that it is a valuable complement to biopsy or curettage because the cytological method covers a larger area *6* it may reveal carcinoma although biopsy may have failed and *7* it has unique value in following operative and radiologic treatment. On the other hand, this method does not indicate the grade of malignancy, does not supply information about metastatic activity or relationship to adjoining normal tissue, and the average time required for carefully studying a smear is longer than for a pathologic section The identification of carcinoma by the cytological method depends upon recognizing the characteristics of the malignant cells which are constantly being exfoliated from malignant neoplasms having a free surface[68]

The morphological character of malignant, yet not invasive, epithelium is characteristic and is so consistent that not infrequently a brief low power examination is all that is necessary to recognize its neoplastic nature Younge asserts that preinvasive carcinoma resembles the type of epithelium frequently found at the edge of an invading cancer[69] From his cytological studies Papanicolaou says that cancerous cells should show *1* Anisocytosis, *2* Anisokaryosis, *3* Hyperchromasia (abnormally densely stained karyosomes and nuclear membrane), and *4* abnormal mitotic figures[64] Reagan emphasizes that alterations in the appearance of the nuclear chromatin are the most important morphological feature in identification of the tumor cells, and that nuclear characteristics are important in differentiating cells derived from carcinoma *in situ* These nuclei are usually only slightly larger than the nuclei of the normal parabasal type cells of comparable size[72] Papanicolaou further describes his criteria for recognizing cancer cells as both cytological and histological This includes *1* variation in size of nuclei many of which are enlarged, both absolutely and relatively to the amount of cytoplasm, and *2* variation in shape of nuclei which also figure prominently in identification of tumor cells He includes other nuclear characteristics as abnormal clumping of chromatin, hyperchromasia, and enlargement of nucleoli Less reliable are cytoplasmic criteria, but frequently there will be vacuolization and at times cytoplasm will show engulfment of other cells[75] In spite of the apparent simplicity of recognizing cancer cells, there are numerous warnings that an experienced cytologist is absolutely necessary in this method of diagnosing carcinoma[31, 63-72, 84]

After the cytological technique in the diagnosis of cancer of the female genital tract became well established, Papanicolaou says it was logical to attempt the same method in study of other systems[64,68,70] This has been used successfully in study of centrifuged sediment of prostatic secretions, urine, sputum, bronchial smears and washings, gastric content, gastric-*duodenal content* and esophageal washings, laryngeal smears, nasopharyngeal smears, rectal mucus, acitic and other fluids. There are by now numerous reports of carcinoma *in situ* discovered on the basis of cytologic smears in various organs.[2,3 17 22 23 37 41 42,43, 46 6 69 70 73,87 88]

There existed a reticence on the part of some pathologists to diagnose carcinoma without invasion[28 36 59] Foote and Stewart comment, ' This is hardly logical since it is so much more reasonable to conclude that if the tumor had *not* been a carcinoma prior to infiltration, then infiltration would not have occurred "[28] Moreover, various histogenetic studies link intraepithelial carcinoma with invasive carcinoma This is undoubtedly true in Bowen's disease and in carcinoma *of* the cervix.[57 73 74,81] Younge commenting on Smith and Pemberton's *cases reported in 1934, points out that five of the 16* cases were not diagnosed carcinoma *in situ* on the original biopsy, but only on reviewing the original sections three and one-half to twelve and one-half years later when these patients began to develop invading carcinoma of the cervix. Younge describes two additional cases in which the original biopsies were considered benign, and reclassified only two *to* three years later when invading carcinoma developed[89] Pund and associates studied 1,200 surgically removed cervices. They concluded that the preinvasive stage becomes invasive after a variable latency averaging five *to* six years, which seems to be the length of time required for endocervical carcinoma to develop sufficient penetration and ulceration of the vaginal surface of the cervix to become obvious.[71] Younge, Hertig and Armstrong describe an early case of carcinoma *in situ*, diagnosed by biopsy because healing would not follow cauterization of the cervix, and in which the carcinoma became invasive in 11 months[90] Hertig Sommers and Bengloff describe repeated biopsies on 11 patients showing sequential endometrial changes which advanced from carcinoma *in situ* to typical carcinoma[39] Black and Ackerman believe that qualified, independent investigators, who have described about 30 cases, have well documented evidence that carcinoma *in situ* of the cervix has been followed by invasive carcinoma[6] Black and Ackerman have studied epidermoid carcinoma *in situ* of the bronchi and lungs and concluded that "evidence has accumulated that epidermoid and undifferentiated tumors of the major bronchi may arise first as islands of carcinoma *in situ*" They describe the initial phase as a progressive metaplasia of the surface epithelium with cellular hyperactivity in the basal layer, increased mitotic activity of the basal layer produces packing of nuclei, increased stratification, and thickening of the epithelium, mitotic activity increase as the basal cell activity extends closer to the surface Finally all layers are involved, and the ciliated superficial layer no longer is present Preinvasive carcinoma of the bronchus is present with the changes extending through all layers to the surface from the intact basement membrane They reviewed 60 recent pneumonectomy cases and found that in 35 per cent of these either marked anaplasia of intact epithelium or frank carcinoma *in situ* was closely adjacent to invasive carcinoma[6] There seems little reason to doubt that preinvasive carcinoma, if uninterrupted by effective treatment, will eventually cause the death of the host[32]

The laryngeal epithelium may undergo the same type of progressive cellular alteration as occurs in the uterine cervix with the development of increasing activity in the basal layer, increased mitotic activity, packing of nuclei, increased stratification, and development of carcinoma *in situ*,[1] therefore, it should be possible to discover carcinoma of the larynx in the preinvasive stage when the best chance for cure exists

Such reports are beginning to appear in the otolaryngologic literature Clerf reported an unusual case of carcinoma of the larynx diagnosed by Mackenty in 1927 Laryngectomy was refused until 1938 when it was performed by Clerf After review of the tissue and original biopsy by another pathologist, it was thought that this might have been a case of 'Bowen's disease of the larynx.'"[14] Brighton and Altmann reported six cases of carcinoma *in situ* from the upper respiratory and alimentary tracts. There were two cases from the larynx and one each from nasal septal mucosa, tonsil, oral mucosa and pharyngeal mucosa.[8] Snitman advocated serial section of all removed laryngofissure masses to avoid incomplete removal of tumor, and to find previously unrecognized tumor. He reports a case with carcinoma completely removed from the anterior and middle thirds of the left cord, but with carcinoma *in situ* in the anterior portion of the right cord.[26] Gordon found carcinoma *in situ* underlying keratosis of the larynx.[15] Brunner has reported a case of superficial epidermoid carcinoma of the larynx associated with trichinosis of laryngeal muscles.[11] For several years Papanicolaou's technique has been employed by Siebert for studying laryngeal and nasopharyngeal smears.[30] Bryan and Bryan, who at first utilized Papanicolaou stains to study epithelial cells during upper respiratory infections,[12] since have studied many smears from various areas of the upper alimentary and respiratory tracts.[13] Their reports have been of great help in diagnosing malignant neoplasms, and in evaluating the results of irradiation treatment. Schoolman advocates both biopsy and cytologic smears from the *nasopharynx* in order that the value of the Papanicolaou technique in this area may be determined.[27] Such developments indicate that earlier recognition of otolaryngological malignancies may be expected. In hope of stimulating interest in problems associated with carcinoma *in situ* in otolaryngology, the following cases are described.

CASE REPORTS.

Case 1. L. M. M., a 27 year-old single white female laboratory technician, a private patient, complained of slight hoarseness for about six months when first seen in October, 1948. She was worried about cancer. She had a quiescent, compensated rheumatic heart and normal blood pressure. Physical examination otherwise was entirely normal except for the presence of two very small, smooth laryngeal nodules, one on the free edge of each vocal cord at approximately the junction of the anterior and middle thirds. These nodules were in contact on phonation. The color of the cords was a normal pearly white and that of the nodules was a flat light gray. There was no redness surrounding the nodules.

She entered McMillan Hospital Oct 19 1948 The nodules were removed the following morning without difficulty by the suspension method, using laryngeal cup forceps The nodule on the left cord was minute, and the larger nodule on the right cord was about the size of the head of a common pin There was no clinical suggestion of malignancy Because of the possibility of papilloma, the denuded areas of mucous membrane were carefully touched with a very small amount of 25 per cent silver nitrate solution on a laryngeal applicator

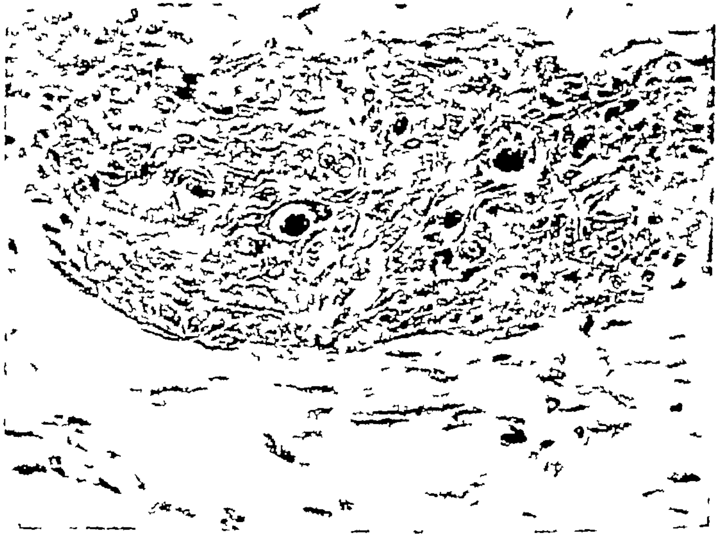

Fig 1 Case 1 L M M Carcinoma in situ of left vocal cord Oct. 20 1948 300×

We were concerned, indeed the following day to receive a diagnosis of carcinoma *in situ* of both cords by Dr Parker A. Beamer of the Washington University Pathology Department. This diagnosis was confirmed also by Dr Lauren Ackerman and Dr Robert A. Moore

The specimens consisted of three pieces from the left cord, the largest of which measured 2 x 1 5 x 0 5 mm and two pieces from the right, the larger of which was 3 x 2 x 2 mm The squamous epithelium bilaterally showed disarrangement of its structure There were large cells, many of which showed mitotic figures and tended to arrange themselves perpendicularly to the surface There was no invasion below the basement membrane There seemed to be no doubt that carcinoma *in situ* was bilateral

She was presented at the weekly conference of the Department of Otolaryngology, Washington University, for therapeutic recommendations Diathermy excision under suspension laryngoscopy as advocated by Dr Gordon New was considered Dr Ackerman felt that a curative dose of X radiation could be recommended on the basis of the pathologic cell changes, however, because of her hospital association and availability for daily laryngeal study, it was decided to keep her under the closest observation, to rebiopsy if any suggestion of a recurrence could be seen and to defer any specific treatment at that time. Her larynx healed nicely Daily laryngeal examinations gradually became weekly then every two weeks, then monthly Her voice is good. There has never been any suggestion of recurrence. On one or two occasions she has been slightly hoarse for a few days during a head cold. She remains under regular observation.

This case clearly illustrates the necessity for careful pathological study of even the most minute laryngeal specimen. It also demonstrates the feasibility of close observation of the larynx for evidence of recurrence because of its accessibility If recurrence is ever suggested immediate cytologic and histologic studies will be indicated If cancer cells are found, an adequate type of treatment must be instituted without delay

Case 2 G L. P., a 54-year-old white male private patient a masseur complained of intermittent huskiness for about three years which had been worse with colds. There was no history of weight loss, cough, or loss of appetite or strength. He was a moderate cigarette smoker When first seen in April, 1950 he was slightly hoarse. There was moderate diffuse chronic thickening of both true cords which were dull gray The laryngeal appearance suggested hyperkeratosis. In addition the left cord presented a slightly yellow area, 3 to 5 mm in diameter on its superior surface near the vocal process, and a small gray nodule on the free edge near the junction of the anterior and middle thirds. The epithelium of the right true cord was similarly and uniformly thickened General physical condition was good. Blood pressure was 120/70 A chest film was negative.

He was admitted to McMillan Hospital. The following day April 15 1950 suspension laryngoscopy was uneventful The thickened membrane stripped easily from the right cord, and was removed in four pieces from the left cord with laryngeal cup forceps. There was minimal postoperative discomfort.

The pathological diagnosis was hyperplasia on the right and carcinoma *in situ* on the left. Two pieces from the left cord showed thickened but otherwise normal epithelium with edema of the stroma. The other two pieces were described by Dr Edward B Smith of the Washington University Department of Pathology as showing very interesting epithelium with thick parakeratotic corneum and acanthotic underlying prickle cell zone. The latter zone forms wide, rounded rete pegs in which two abortive epithelial pearls and several mitotic figures are found One mitotic figure is atypical. The basal layer is intact in every sector

His larynx was watched carefully during healing The cords regained a fairly normal appearance and his voice was good. Approximately four months later he developed a fever and cough This apparently was due to a second malignancy developing very rapidly in the right hilar region He would not consent to endoscopic examination until late in October 1950 At bronchoscopy the tumor was not accessible and the vocal cords remained entirely normal in appearance. Exploratory thoracotomy elsewhere revealed adenocarcinoma.

This case history illustrates the almost simultaneous development of distinctly different, primary malignant tumors in the same patient, the laryngeal being of squamous cell origin and the bronchogenic tumor showing adenocarcinoma. This man did not survive sufficiently long after the removal of his laryngeal carcinoma *in situ* for any conclusions to be drawn about the tendency of the laryngeal tumor to recur This patient is one of many in various fields of medicine who have been shown in recent years to have developed distinctly different and secondary primary malignancies

Case 3 M S B, a 58-year old white male, a grocery clerk, was admitted to the Washington University Otolaryngology Clinic with a 15-year history of hoarseness, which had been worse for three or four years.

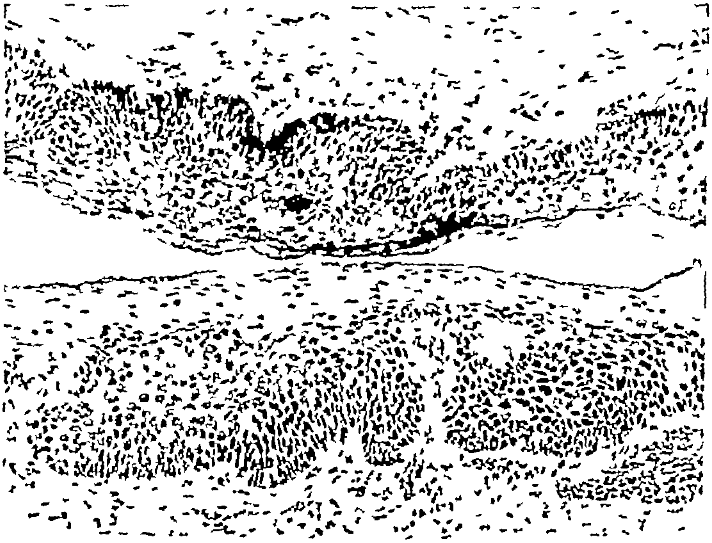

Fig 2 Case 3 M. S B Sections from laryngofissure block Dec. 19 1950 Epithelial layer above showing changes throughout its entire depth adjacent epithelial layer below demonstrating marked basal layer changes approaching the surface basement membrane remains intact.

There was a small laryngeal nodule projecting medially from the middle third of the right true cord This was smooth There was no ulceration. The nodule was in contact with the left cord on phonation His blood pressure was 210/110 and there was moderate cardiac enlargement

Oct. 25, 1950, the laryngeal nodule was removed at McMillan Hospital and showed epidermoid carcinoma *in situ* Rebiopsy of the right cord was done Dec 5 1950, and the report again was carcinoma *in situ* Anaplasia and hyperchromasia in the epithelium was confined within the basement membrane There were a few broad papillae extending into the stroma. On Dec 19, 1950 a right laryngofissure was done Noninvasive carcinoma was present in several areas of the surgical specimen There has been no apparent recurrence to this time

This case is included in this report through the courtesy of Dr J Ogura, Dr J West and Dr L Gurnee, and illustrates the occurrence of carcinoma *in situ* of a laryngeal nodule and of that side of the larynx in a patient whose hoarseness had existed for at least 15 years This preinvasive cancer was eradicated by adequate treatment

Case 4 A. M., 78-year-old white male, proprietor of a barber shop private patient of Dr M. F Arbuckle, through whose courtesy this case is described was admitted to McMillan Hospital June 2 1948 for laryngeal biopsy because of fusiform red thickening of the right true cord Hoarseness was first noted seven months earlier after he had strained his voice in public speaking. Hoarseness had not been constant but was noted if he talked for any length of time. General physical condition was good Blood pressure was 150/90 He had suffered some previous anginal symptoms. Electrocardiogram was normal Several biopsy specimens were taken through the anterior commissure laryngoscope. The clinical appearance was not very suggestive of malignancy Three pieces of tissue were described as soft, pinkish or grayish. The largest specimen was 4 x 3 x 2 mm. The pathological description included fibrous tissue linked by respiratory and metaplastic epithelium an intact basement membrane areas of hemorrhage in the fibrous tissue, and large deeply pigmented cells. Nothing in the report suggested that the sections had presented any special diagnostic pathologic problem. The diagnosis was "laryngeal nodule."

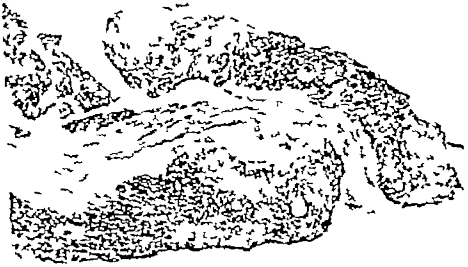

Fig 3. Case 4 A. M. *Original biopsy of right true cord*, June 2 1948 Epithelium was described as metaplastic. Diagnosis of carcinoma in situ was made on review by *another pathologist 15* months later after frank invasive carcinoma was almost beyond the limit for laryngofissure Failure to consider original biopsy tissue malignant was an "error of omission fraught with danger" to this patient. 85X

Hoarseness continued. In September 1949 he again consulted Dr Arbuckle, saying that for the last five or six weeks his *voice* had been worse and that talking was painful at times. The right true cord was red thickened, with an elevated, definite malignant appearing lesion His general physical condition was *relatively good* He could walk seven or eight blocks without discomfort. Blood pressure was 166/88 Dr Edward B. Smith and Dr Lauren *Ackerman who* had not seen the original slides, were asked to review these sections. It was their opinion that carcinoma *in situ* was present in the first biopsy 15 months earlier

Multiple biopsies were taken by Dr Arbuckle from the right true cord on Sept 21, 1949 The lesion extended from the anterior commissure almost to the vocal process The cord was not fixed, the other cord appeared normal Dr Smith described this tissue as having a basement membrane not always intact, epithelial cells migrating into the stroma in an irregular manner, detached cords, sheets and strands deep in the stroma, showing in some places small epithelial pearly formations The cells in general showed irregular and hyperchromatic nuclei with intercellular bridging The diagnosis was epidermoid carcinoma, grade II.

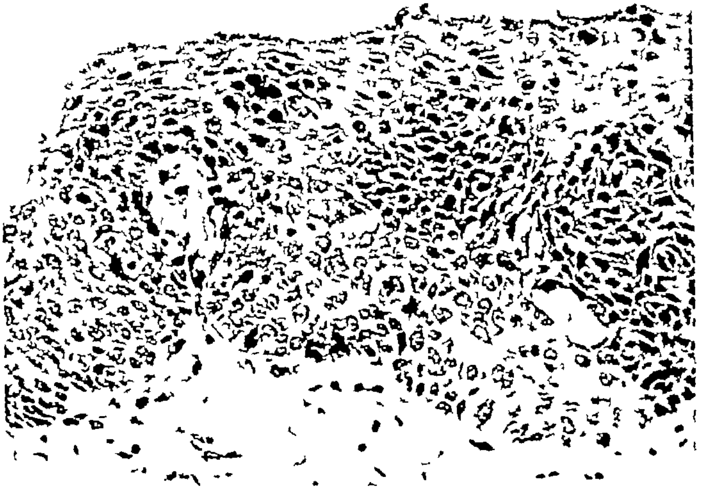

Fig 4 Case 4 A. M Biopsy of right true cord Sept. 21 1949 showing invasive carcinoma Review of original biopsy proves that preinvasive carcinoma or carcinoma in situ existed in June 1948 Preinvasive carcinoma has progressed in this larynx to frankly invasive cancer in 15 months. 255×

Laryngofissure was performed on Sept 26, 1949 Three or 4 mm of the opposite cord were removed with the right laryngofissure block because of possible extension across the anterior commissure Pathologic study showed a 3 mm margin anteriorly Laterally the tumor had deeply invading pegs of moderately large cells extending to within a few millimeters of the periochondrial boundary There was a moderate number of mitotic figures He recovered satisfactorily and is still free from laryngeal symptoms or signs of recurrence

This case illustrates the error of omission in failing to diagnose carcinoma *in situ* on original biopsy—an 'error fraught with danger to the patient," as pointed out by Broders in 1932 It also proves that preinvasive carcinoma of the larynx became frankly invasive, and was, therefore, cancer 15 months earlier at the time of original biopsy

Case 5 L H, 38-year-old white male a farmer, was admitted to the Veterans Administration Hospital, Jefferson Barracks, Mo, on Oct. 30, 1950 because of backache which had been present since his wartime army service He had thoracic kyphosis and scoliosis, and walked with a poker back. Also there were palpable discrete nodes in the right side of the neck. He was seen in consultation by the otolaryngology service Search for a cause of the adenopathy revealed a small nodular white mass of tissue in the right glossoepiglottic fold Tissue was removed from this area for microscopic diagnosis on Nov 4 1950 Sections showed typical carcinoma *in situ* however, additional tissue was requested by Dr Franz Leidler and Dr Lauren Ackerman, pathologists both of whom suggested that carcinoma may be originating in multiple

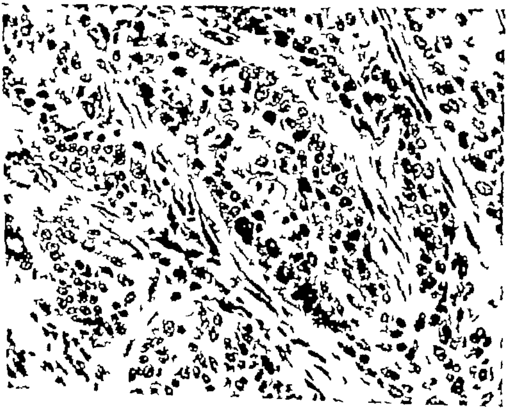

Fig 5 Case 4 A. M. Tissue removed at laryngofissure, Sept. 26, 1949 showing invasive epidermoid carcinoma. 55×

foci as is common especially about the oral cavity and that this carcinoma *in situ* probably was closely adjacent to invasive carcinoma or that it was actually the advancing edge of a frankly invasive cancer On the second biopsy typical invasive carcinoma was found within a centimeter of the original biopsy

This is an illustration that the possibility of inaccurate diagnosis of preinvasive carcinoma must be avoided by great care Consultation of clinical and laboratory physicians minimize such dangers as incomplete or improper diagnoses.

SUMMARY AND CONCLUSIONS

Carcinoma *in situ*, intraepithelial carcinoma or preinvasive carcinoma is the earliest form of recognizable cancer This is the initial microscopic, irreversible morphologic change in tissues which eventually will kill the host if not controlled by adequate therapy Alterations in cellular structure and arrangement are unquestionably neoplastic, but the essential factor of invasion is absent The lack of penetration and the intact basement membrane have been potent deterrents in acceptance of the idea that early cancer can be diagnosed in the absence of infiltration The preinvasive characterization infers the invasive potentiality which changes early cancer into advanced cancer

Diagnosis of carcinoma without invasion depends upon recognition of the characteristics of cancer cells Histologic and cytologic studies of cancer cells have been narrated Cases of preinvasive carcinoma progressing to invasive cancer have been recounted Knowledge of cellular changes and their potentialities clarify the concept that carcinoma *in situ* is malignant and requires courageous, prompt treatment to eradicate cancer in the early stage

Preinvasive carcinoma is clinically invisible More frequent biopsies and greater use of exfoliative cytology are making carcinoma *in situ* relatively commonplace Until a better method is available for early diagnosis, reliance must be placed on constant vigilance, unrepressed suspicion, more biopsies and cytologic studies, and the collaboration of an experienced pathologist

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This paper was reviewed in the VA and published with the approval of the Chief Medical Director The statements and conclusions published by the author are the result of his own studies and do not necessarily reflect the opinion or policy of the VA

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SECRETORY OTITIS MEDIA *

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Secretory otitis media is one of the most important and often most perplexing otologic problems in office practice today, although it has not received the attention it deserves

The purpose of this paper is to review the literature, both old and recent, to discuss and attempt to evaluate certain aspects of the condition with particular interest in etiology, pathology and treatment, and to record some of my observations on 372 patients with acute, subacute and chronic secretory otitis media seen in private practice during a five and one-half year period from January, 1946, to July, 1951, inclusive

The term secretory otitis media, as used in this discussion, is intended to include all patients who present themselves with an accumulation of serous or mucus (nonpurulent) fluid in the middle ear and usually the mastoid cavity as well Synonyms include otitis media with effusion, serous otitis media, catarrh of the middle ear, tympanic hydrops, tubotympanic catarrh, etc As Hoople[1] has pointed out, none of these terms by itself is adequately descriptive of this disease from an etiologic or pathologic standpoint "Secretory otitis media" implies a true glandular secretory activity on the part of the mucosa but this is probably minimal or even absent in most cases, as will be brought out later The term "otitis media with effusion" implies that an inflammatory process is involved, which also does not hold true in all cases For want of a better term, however, these two will be used synonymously in this paper

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HISTORICAL NOTE

Many of us tend to look upon this condition as a new entity because our own experience with it is relatively recent, but upon reviewing the older literature we may well be amazed to find that Politzer[2] described it in accurate detail in 1869 and devoted 20 pages to it in the fifth edition of his book in 1909 Little has been added to our knowledge of this condition except in the fields of chemistry and allergy, and perhaps concerning the influence of the autonomic nervous system upon capillary permeability

In 1906, Kyle[3] also discussed the treatment of catarrh of the middle ear and approved the practice of myringotomy and inflation. Some others[4] at this time were advocating the use of such measures as medicated vapors and superheated compressed air insufflated into the Eustachian tube Ballenger,[5] in 1908, gave a good description of the mucus type of acute otitis media, as did also Phillips[6] (1919) and Kerrison (1923) in their respective textbooks

Then followed a period during which the teachings of Politzer were either forgotten or ignored and fluid in the middle ear received little attention. With the exception of an excellent case report in 1927 by Lawson,[8] no clinical papers on otitis media with effusion appeared in the American literature until 1940 The subject of acute catarrhal otitis media had been well covered in most of the textbooks, but little had been said concerning chronic otitis media with effusion until recent years after interest in this subject had been restimulated by Jones,[9] Hoople and Blaisdell,[10] Hantman,[11] Robison[12] and others.

There is still a great deal of confusion and uncertainty concerning the etiology and pathogenesis in many of the chronic cases. As one observes and treats these patients over a period of years, there are certain questions that arise. Among those that have occurred to me some of which have been proposed by others are these

1 Why do some individuals with an obstructed Eustachian tube and retracted drum develop an accumulation of fluid in the middle ear while others do not?

2 Why do some cases become chronic with little or no evidence of pathology in the nose, sinuses, nasopharynx or Eustachian orifice?

3 Why do some continue to have fluid in the tympanum in the presence of an apparently open Eustachian tube?

4 Why do the majority of reports of large series of cases come from otolaryngologists practicing in coastal areas and river valleys, or in other words, is the incidence of secretory otitis media influenced by altitude and humidity, or either of them?

5 Does determination of the protein content of the fluid have any practical value? Can one determine the origin of the fluid by determining the protein content, and is there any correlation between protein content and cytology of the fluid?

6 Are eosinophiles commonly found in the ear fluid when the tubal obstruction is the result of allergy?

The author has not found the answers to all these questions during the course of this study but has satisfied his curiosity with regard to some of them

PATHOGENESIS

Sterile fluid in the middle ear apparently may occur as the result of one or both of two pathological processes

It may occur as an effusion resulting from the action of negative pressure on the thin walled arterioles and capillaries in the mucosa of the middle ear, the vacuum of course being the result of Eustachian tube obstruction ascribable to one of many possible causes Transudation due to a vacuum alone occurs in the purest form in aero-otitis media, which Hantman[11] refers to as a "hyperacute" secretory otitis media

Secondly, it is said that fluid may occur as a response to low grade inflammatory reaction in the mucosa of the Eustachian tube and tympanum, secondary to infection in the nose or throat, in which case it is an exudate, but free of bacteria

In many cases the fluid is a result of both these influences, that is, a mixture of transudate and exudate, with varying amounts of each

ANATOMICAL CONSIDERATIONS

A review of the anatomy and histology of the Eustachian tube and tympanic cavity brings to one's attention several facts which may be of interest in the pathogenesis of this disease

1 Eggston and Wolff[14] found that great variations in the size of the isthmus of the tube exist even in individuals of the same age This may be one reason why some people develop tubal obstruction and effusion more readily than others under similar circumstances

2 These authors state further that under normal conditions the tympanic mucosa consists of low cuboidal epithelium and the submucosa is often just thick enough to transport the relatively small blood vessels nerves and lymph channels.

3 Eggston and Wolff have noted also that "the arteriolar walls are very delicate and frequently one can observe blood corpuscles in the act of escaping from the vascular channels at the time of fixation of the tissues."

Keeping the above facts in mind, one can readily see that the histologic structure of the middle ear is ideal for the effusion of serum in the presence of a vacuum however, according to these same authorities, the mucosa is subject to "abrupt and marked changes under apparently slight stimulus," and by a combination of edema and actual multiplication of cells it may become several times its normal thickness.

The variability in the thickness of the mucosa and differences in capillary permeability are possible explanations why some middle ears develop an effusion and others do not.

The origin of the serous fluid in this disease is undoubtedly from transudation of fluid elements of blood serum through the thin walled arterioles and capillaries in the submucosa of the tympanic and mastoid cavities, but the origin of the "mucus type" fluid warrants more discussion Politzer[7] and others have stated that it is the mucosal response to inflammation, but if the mucosa contains no secreting acinous glands one may wonder about the "secretory" origin of the fluid Lowy,[14] too, was particularly concerned with the origin of the exudate He believed that it must, of course, originate in the vessels, but was interested in determining if the cellular elements of the mucosa play an active part, that is, whether a true secretory process is involved He proceeded on the premise that a secretory activity on the part of the epithelium should produce changes in the constituents of the serum and, on the other hand, if only an increase in permeability is involved, the exudate should retain the essential characteristics of the blood serum He was able to demonstrate the identity of the blood group (type) in the middle ear exudate in each of 15 cases examined, whereas this proved impossible in the exudate of cases with suppurating otitis He also proved by biopsy of the middle ear mucosa in a child with secretory catarrh (who had died of other causes) that severe mucosal edema existed His conclusions were that a simple increase in the permeability of the capillaries favors the development of a serous otitis media and that his investigations do not indicate an active secretory activity on the part of the mucosal epithelium

Lawson[8] states that "the mucus in the mucus type of the disease comes as a result of the closure of the Eustachian tube It is the normal secretion of the mucous glands within the tube and may be increased temporarily to balance the external atmospheric pressure"

The presence of the mucus (not serum) in the middle ear, therefore, may be explained in one or both of two possible ways *1* because of blockage of the tube at its pharyngeal end, mucus secreted by acinous glands in the pharyngeal portion of the tube may have made its way by retrograde flow into the tympanum, 2 it may have been secreted by newly formed goblet cells in the tympanum Quoting from Eggston and Wolff,[14] "No glands are present in the submucosa of the middle ear Normally not even goblet cells are evident in the mucosa but in the presence of infection they may occur How this tissue is kept moist is not known"

The evidence, then, favors the view that most of the fluid originates in the blood serum under the influence of negative pressure alone or by the added influence of inflammation and increased capillary permeability It may be added to or replaced in some cases by the secretion of mucus by acinous glands in the Eustachian tube and by the goblet cells in the tube and tympanic cavity The secretion by goblet cells in a metaplastic mucosa may explain the persistence of fluid in some ears after the Eustachian tube has become patent.

ETIOLOGY

As has been mentioned in the preceding paragraphs, the primary factor in the etiology (of otitis media with effusion) is an obstructed Eustachian tube Any condition which is capable of producing swelling of the tubal mucosa, compression of the ostium or lumen of the tube or in any way interfering with the normal tubal function must be considered a possible etiologic factor Robison[11] is of the opinion that the obstruction is often due to mechanical lymphatic blockage, secondary to inflammatory swelling of the lateral retropharyngeal lymph nodes which drain the sinuses and naso pharynx as well as the middle ear resulting in retrograde lymph circulation and lymphedema of the tubal mucosa at the isthmus.

In addition to upper respiratory infections and lymphoid hyperplasias, there are many other local conditions which may be causative or predisposing factors. Allergy is an important and probably often overlooked cause, but on the other hand, we must be careful not to assume an allergic etiology merely because there is no other immediately obvious pathology Dental malocclusion, tumors of the nasopharynx, and paralysis of the tensor veli palatini muscle account for a small percentage of cases each Marked septal deviations and cleft palate are predisposing factors

Some of these patients have probably had a long standing partial obstruction of the tube because of a traumatic adenoidectomy or a previous suppurative otitis media They tend to have a recurrence of serous effusion into the tympanum with each upper respiratory infection

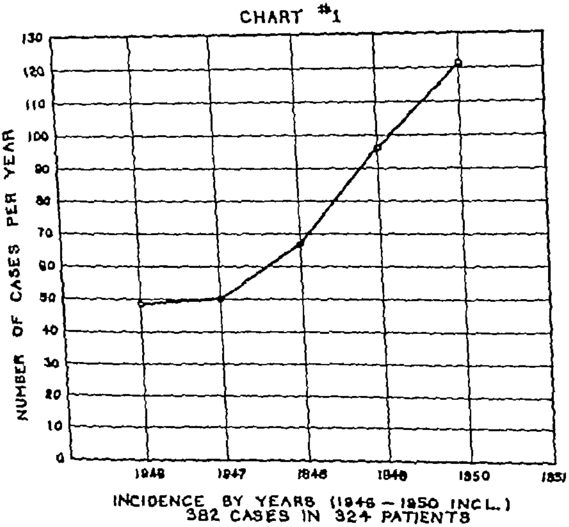
Most of us who have been disappointed with the results of our treatment have suspected for some time that obstruction of the Eustachian tube is not the only factor in the persistence of effusion into the middle ear What else, then, may play a rôle in the persistence of the fluid? Hoople[1] has mentioned systemic conditions which abnormally affect tissue fluid balance namely, allergy, cardiac insufficiency, cardiovascular-renal disease, and endocrine disturbances as potential sources of trouble, particularly in persistent chronic cases These diseases probably affect the water balance by increasing the capillary permeability Other conditions which increase capillary permeability may be important primary or secondary causes of effusion in the middle ear Hilger[15] has pointed out that autonomic dysfunction, which is sometimes the result of psychic disturbance, may result in arteriolar spasm and capillary dilatation Williams[10] has recently discussed the relationship of autonomic dysfunction to allergy In an extensive review of the literature, he points out that anoxia in the involved tissue leads to increased capillary permeability and that "destruction of the leucocytes in the capillary loop together with more or less injury of other involved cells would result in the release of histamine, which also would increase capillary permeability" It seems reasonable that these effects of autonomic dysfunction could occur also in the middle ear and favor the continuance of an effusion in some cases

INCIDENCE

I — Increasing in frequency?

That there has been an increase in the incidence of otitis media with effusion since 1940 is generally believed to be true, but the reasons for the increase have not been agreed upon by various authors The theories advanced to explain the greater incidence are as follows

1 *Increased vigilance* on the part of otolaryngologists, once they have learned to recognize the condition, is believed to be the chief factor by Hoople[1] and also by Jordan[17] This has certainly been true in my experience as shown by the accompanying Chart 1 Prior to service in the Army, the author recognized very few cases and since 1946 has observed a steady increase in incidence chiefly because he has looked for the disease



2 *Virus infection* Eagle[18] and others are of the opinion that many of these cases are due to viral infections in the

middle ear. The fact that the fluid is found sterile by ordinary culture methods does not, of course, preclude the possibility of a virus infection. Viruses inhabit tissue cells and are not found in the intercellular spaces or tissue fluids. Lawson,[8] while discussing the possible reasons for the sterile condition of the fluid, included the possibility that the investigative methods may be insufficient, that the organism may be ultra microscopic, and further that the organisms may be in the mucosa but not in the exudate. Although Lawson did not mention the term "virus," all these criteria would hold true for a virus infection. Further investigation is needed to prove or disprove this theory.

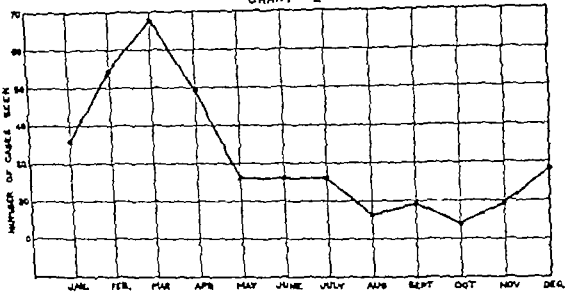
3. *Hypovirulent infections* due to increasing use of antibiotics and chemotherapy are believed by Hall[19] to be the cause of the increasing frequency. Lawson[8] and Lederer[20] also refer to hypovirulent infection as a possible factor in the etiology of this disease. Hoople[1] has noted only a 20 per cent increase in the incidence of fluid in the ear since the advent of chemotherapy, most of the increase being found in children. Many of the cases of mucus otitis media seen in children undoubtedly represent aborted acute otitis media that would have become suppurative had they not received antibiotics. There are those, however, with mucus otitis media who have not received any medication.

II.—Influence of Climate

1. Temperature in itself is not believed to be an important factor except that the condition occurs most frequently in seasons of the year when the temperature is most variable and hence when upper respiratory infections are most prevalent. In the author's locality the largest number of cases were observed during the months of February, March and April (as shown in Chart 2), which happen to be months of extremely variable temperature. This has been observed also by others.

2 Altitude and humidity were first mentioned by Politzer,[2] and later by Ballenger,[5] Eagle[10] and Hantman,[11] as being possible influencing factors in the incidence of this disease Their importance has been questioned by others While re-viewing the literature for this thesis the author was impressed by the fact that most reports of large series of cases came from otolaryngologists residing in coastal areas and along river valleys where the altitude is relatively low and the humidity high. Well qualified otolaryngologists residing in localities where the reverse conditions of altitude and humidity prevail were questioned regarding the incidence of secretory otitis media, and their responses with one exception (Boulder) were to the effect that even though they were on the alert for such cases they saw only a few per month or a few per year

CHART #2



INCIDENCE BY MONTHS FOR 5 YEAR PERIOD
(1946 – 1950 INCL.)
382 CASES IN 324 PATIENTS

Localities of reported high and low incidence with their respective ground elevations and relative average humidities are shown in Table 1 It is admitted that this survey is incomplete, but it seems reasonable to assume that an individual with pre-existing pathology in the Eustachian tube is

TABLE 1

INCIDENCE IN VARIOUS LOCALITIES, SHOWING GROUND ELEVATION AND AVERAGE RELATIVE HUMIDITY

Essavist or Reference	Location	Ground elevation above sea level (feet)	Average relative humidity	Incidence
Jones, C C [9]	Cincinnati, Ohio	533 ft	79 2%	High
Hotchkiss, W [22]	Miami, Fla	8	77 2	High
Hall, S S [20]	Clarksburg, W Va	977	76 7	High
Robison, J M [12]	Houston, Texas	138	76 0	High
Farrior, J B [23]	Tampa, Fla	24	75 5	High (Approx 6 per week)
Lantman, Irvin [11]	Keesler Field, Miss	9	74 7	High
Shahinian, L [24]	San Francisco, Cal	52	73 6	High
Earle, Matt [19]	Durham, N C	406	72 0	High
Hoople, Gordon [1]	Syracuse, N Y	424	71 7	High (3-4% of total pts)
Lindsay, John [25]	Chicago, Ill	611	71 7	High
Author		621	69 5	High
McDougall, C [26]	Atlanta, Ga	977	69 2	High
Jordan, Ray [18]	Pittsburg, Pa	1248	68 5	High
Hickey, N L [27]	Denver, Colo	5292	52 7	Very low (Approx 6 per yr)
Bradley, J W [28]	Colorado Springs, Colo	6175	50 7	Low except in Spring months then 6-8/mo
Lamberson, W H [29]	Colorado Springs, Colo	6175	50 7	Low
Richardson, Geo [30]	Albuquerque, N M	5310	46 2	Very low Almost nil
Cruthirds, A E [31]	Phoenix, Ariz	1083	41 7	Very low (3 per 500 pts
Spearman, M P [32]	El Paso, Tex	3936	40 2	Extremely low Almost nil
Page, Donald [33]	Boulder, Colo	5400	35-40?	Low except in Winter

more likely to develop tubal obstruction and effusion in a moist climate at or near sea level than he would be in a high dry climate

III — Age Incidence

Secretory otitis media may occur at any age but is most prevalent in young children, undoubtedly because they have more upper respiratory infections than any other age group, and because they are predisposed to tubal obstruction by enlarged adenoids or by hypertrophied lymphoid tissue in the fossa of Rosenmüller and furthermore by the smaller size of the pharyngeal opening of their Eustachian tubes as pointed out by Tremble[34] In the author's series, 120 of the total or almost one-third of the patients were children under 10 years of age The examination of many of these children was prompted by impaired hearing as discovered during school hearing surveys

For convenience of discussion, the author's series of 372 patients was divided into acute, subacute and chronic groups, depending upon the duration of the attack. The cases termed acute were of short duration with disappearance of the fluid within less than three weeks from the onset of symptoms. The subacute cases persisted from three to six weeks, and those termed chronic continued to have fluid in the middle ear for a period of six weeks to several years. One patient with malocclusion gave a history of having had symptoms for 10 years.

The various causes for each group are shown in Table 2 Many of these patients had more than one etiologic factor but only the predominant one was selected When active nasal allergy persisted, it was listed as the primary cause.

In the author's experience an upper respiratory infection was the exciting cause in almost two-thirds of the cases Allergy was considered to be the etiologic factor in 37 or approximately 10 per cent of the total number and 11 per cent of the chronic cases even though allergy was constantly kept in mind and searched for Nasal smears for eosinophiles were done almost routinely, and skin tests were done on many of those with questionable signs of allergy The author has not observed any appreciable increase during the ragweed hay fever season, which is very prevalent in his locality from late August to October

In children, hypertrophied adenoids or hypertrophied remnants of lymphoid tissue in the fossa of Rosenmuller were the chief predisposing factors The majority of these children developed bilateral effusion with each cold The greatest lymphoid hypertrophy occurred in the allergic children, as was emphasized by Jordan,[17] but the nonallergic children with large adenoids far outnumbered the allergic ones insofar as

TABLE 2

ETIOLOGY IN 372 CASES

ETIOLOGY	Acute	Subacute	Chronic	Total
Acute U R I	111	35	16	162
Sinusitis	24	16	19	59
Hypert adenoids (without apparent allergy)	7	20	37	64
Allergy	19	7	11	37
Previous Supp O M only cause	0	0	3	3
Aero-otitis	9	1	0	10
Contagious disease (measles, mumps)	2	0	0	2
Pregnancy (Endocrine)	1	0	0	1
Hodgkin's disease	0	0	1	1
Malocclusion	0	2	3	5
Malignancy of nasopharynx	0	0	2	2
Swimming	3	0	0	3
Unknown	7	9	7	23
	183	90	99	372

could be determined It is admitted that there were very probably a number of patients whose obscure allergies were not detected

Among adults, infections of the paranasal sinuses were very prevalent. Most of these had involvement of one or more sinuses on the homolateral side, but curiously enough a small number had involvement only on the ipsilateral side Malocclusion was the only etiologic factor in five, and lymphoepithelioma of the nasopharynx was the cause in two patients, one of these having bilateral effusion

Of interest was the unfortunate fact that the etiology could not be determined in 23 of the total Seven of these ran a chronic course.

PATHOLOGY

As mentioned above, there are two clinical types of this condition, serous and mucus, but many cases constitute a combination of the two

The serous fluid is thin, clear, light yellow and watery when first evacuated or aspirated from the tympanum, but becomes thicker and coagulates when exposed to air It is basically a transudate containing few inflammatory cells and usually has a low protein content, although the protein is quite variable.

The so-called mucus fluid is thicker and tenacious, sometimes turbid, usually very viscid, and much more difficult to remove. It contains many inflammatory cells, mostly polys and usually has a high protein content It is, therefore, an exudate Both are sterile by ordinary culture methods, as shown by Forschner[34] and others

CYTOLOGY

During the past year the author has almost routinely examined smears of the ear fluid stained with Hansel's stain and has observed that the number of inflammatory cells per high power field varies tremendously The thin serous fluid in cases without associated inflammatory disease contains only a few cells per H.P.F., whereas the more tenacious fluid may contain as many as 300/H.P.F. or more, predominantly polys.

I have been particularly interested in whether or not eosinophiles occur in the ear fluid of those patients whose secretory otitis is believed to be the result of allergy. Koch[15] refers to Dohlman's report in 1941-1942, wherein the latter found eosinophiles in the secretion of secretory middle ear catarrhs, chronic otitis and mildly acute otitis, "in certain cases in a very large number," and states that Dohlman considered these to be of allergic origin. He states further that Dohlman has given merely a general survey of his experiences, without any statistics with regard to percentage of eosinophiles found in the secretory otitis medias. Hotchkiss[21] observed that "even in definitely allergic cases, the eosinophilic count is not dependable." The only other published report on the incidence of eosinophiles in secretory otitis media that the author could find was that by Jordan,[16] who stated that he found "occasional eosinophiles" in direct smears of the fluid, and 73 per cent of his chronic cases were attributed to allergy.

I have looked painstakingly for eosinophiles in the ear fluid of at least 50 patients, including all those who had evidence of nasal allergy and those in whom the etiologic factor was assumed to be allergy, and have yet to find an eosinophilia in a single case; furthermore, I have seen only *one eosinophile* in the total of 50 slides examined! I do not mean to infer by this, however, that an absence of eosinophiles in the ear fluid precludes an etiologic diagnosis of allergy as the cause of tubal obstruction. The allergic reaction may be limited to allergic swelling in the pharyngeal end of the tube, thereby creating a negative pressure, without producing a true allergic edema and eosinophilia in the tympanum.

CHEMISTRY OF EAR FLUID

Lowy[14] states that Schlander and Goebel demonstrated by means of protein determination on the middle ear exudate that the fluid is due partially to an exudation and partially to a transudation, and that the majority of the secretory catarrhs can have only an inflammatory origin, but their manuscript is not available for review. There is disagreement among other authors concerning which type of fluid has the highest protein content, the thin serous type or the thick mucus exudate. Robison[12] found a high total protein content in the exudate containing many polymorphonuclear leucocytes and a low protein content in the thin transudative fluid containing a *few polys*. Hoople,[1] on the other hand, states that the thin serous fluid has a high protein, and the thick mucus exudate a low protein content.

According to Cantarrow and Trumper,[14] the protein content of transudates and exudates in various parts of the body can vary tremendously because of variations in the intensity *of the inflammatory process and variations in capillary permeability*. They state that in the case of exudates resulting from inflammatory processes of lesser intensity, such as pneumonic pleurisy and tuberculous peritonitis, the total protein concentration usually ranges from 0.1 to 5 gm. per 100 cc. The *protein content of noninflammatory* edema fluids or transudates is said to be relatively low (0.1 to 1 gm. per 100 cc.), since their pathogenesis is usually independent of alterations in capillary permeability. They state further, however, that if the effusion has existed for some time, water may be reabsorbed *more rapidly than* solids, resulting *in a* slowly increasing concentration of protein which may eventually approach that of true exudates.

I have through curiosity done some protein determinations along with cytologic smears in a small number of cases to see whether there is any constant correlation between the total protein and the number of inflammatory cells in the fluid, which is what one would normally expect.

The fluid was collected by aspiration through the drum with a short bevelled 20 or 22 gauge needle attached to a tuberculin syringe. The volume of fluid obtained by this method varied *from 0.1 to 0.4 cc., but usually* only 0.1 to 0.2 cc. could be collected. The fluid was diluted to 2 cc. with normal saline and protein determination done in the usual manner as for serum protein.

The results, along with the cell count, gross description of the fluid, the etiology and chronicity are shown in Table 3

TABLE 3

Patient	Gross appearance of fluid	Protein content	Cell count	Etiology	Chronicity before trt	Result
#1 M P P	Thin serous	1 25 Gms/ 100 cc	Not done	Cold	1 week	Cleared in 1 week
#2 J F K	Thin serous	1 45 Gms	22/HPF most polys	?	1 month	Fluid persists after 3½ mos
#3 J S	Thin watery light yellow serous	3 4 Gms	18/HPF	Nasal allergy	1 day	Cleared in 1 week
#4 O H R	Thin watery light yellow serous	3 9 Gms	No inflam cells Few rbc/HPF	Partial cicatricial stenosis of E T ? Nasal smear neg	4 months this attack Recurrent since 1920	No follow-up
#5 H L M	Med consis- tency serous	4 4 Gms	23/HPF Predom lymphocytes plus 27rbc/ HPF	Supp max sinusitis, bilat	2 weeks	Cleared in 3 weeks
#6 J L H	Thick mucus glue-like	5 0 Gms	225/HPF Mostly polys	Cold plus narrowed eust orifice Nasal smear neg	3 weeks Hist of similar attack 10 yrs before	Fluid persists after 8 mos Cleared for periods of 6 wks and 8 wks Re- curred with colds
#7 C S	Thin serous	5 25 Gms	No inflam cells Few epithelial cells	Hodgkin's disease Lymphatic blockage?	2 months	Cleared 1 mo after external irradiation
#8 G C	Medium consistency serous	6 2 Gms	26/HPF plus large clumps	Cold Nasal smear neg	6 months	No recurrence
#9 A E J	Medium consistency serous	7 2 Gms	2/HPF plus 10-15 rbc/ HPF	Cold Nasal smears neg	3 months	No recurrence

As shown by a study of the above table, there was no constant parallel between the total protein content and the cell count, although the thin, watery, serous fluid tended to have a lower protein and a lower cell count than the more tenacious fluid. If only two of these were selected for comparison, however, *e g*, No 6, J L. H, who had a thick mucus type of fluid with 225 polys/H P F, definitely an exudate, and No 7, C S, who had a thin serous type of fluid containing no inflammatory cells and without question a transudate, one might come to the conclusion that the protein content of the mucus type is lower than that of the serous type, which is probably erroneous in most cases

The percentage of error due to the dilution factor is estimated to be only approximately 10 per cent. The protein content may be affected very slightly by the presence of a few erythrocytes, but none of the fluid was grossly blood tinged, and I know of no less traumatic method of collecting the fluid than with a needle and syringe The thick mucus fluid is very difficult to collect by any method.

The only conclusion that can be drawn from this study is that a larger number of determinations should be carried out to see whether any correlation can be shown between the gross appearance of the fluid, cell count, protein content, duration of the disease, etc. The author intends to continue this investigation according to this plan

SYMPTOMS

Adults with an accumulation of fluid in the middle ear usually describe their sensations realistically Most complain of a 'stopped up" or "full feeling" in the ear Others state quite accurately that they have water in the ear and at times they can feel fluid moving about or bubbling upon sniffing or forcefully blowing the nose Many will say that the ear feels numb or dead' and this sensation of numbness is imparted also to the skin around the auricle, noticeable upon rubbing the ear or combing the hair on the affected side. These patients usually have a full tympanum and mastoid cavity

Autophony is commonly described as "talking with the head in a barrel" A diagnostic symptom, if the middle ear is only partially filled, is the temporary improvement in hearing upon tilting the head toward the affected side or upon lying down, thus permitting the fluid to drain away from the round window, or probably because the pressure of the fluid upon the round window is relieved thereby

They may give a history of having been treated by other otolaryngologists by inflation with improvement in hearing for a short time

In the case of young children, the only symptom is usually an impairment of hearing which has been noticed by the parents, the school teacher, or after routine school audiograms

DIAGNOSIS

The diagnosis can usually be suspected from the history Inspection usually reveals the characteristic amber or yellow color imparted to the translucent drum, which is not inflamed and may or may not be retracted If the drum is opaque, this amber color usually cannot be detected In long standing cases the drum occasionally has a bluish color, probably due to the congested mucosa on the promontory Hoople[1] has emphasized the chalk white appearance of the malleus handle and short process which gives the impression that the drum is retracted when it may not be at all

If the tympanum is not filled with fluid, one can often see a fluid line or bubbles through the drum, and when these signs are present the diagnosis is readily apparent, however, a full tympanum is encountered many times more frequently than the drum with a meniscus The pneumatic otoscope or Politzerization may be helpful in demonstrating bubbles or a fluid line

The hearing loss, conductive in type, varies with the amount of fluid present The audiometric curve, although not characteristic, is most often flat unless there is a pre-existing inner ear lesion Lowy[37] observed that in approximately one-third of the cases, the hearing loss was severe, with considerable loss in the range of the higher tones. He does not attribute this to damage of the inner ear, but to increased tension and impaired mobility of the fenestra rotunda, as the signs of inner ear impairment largely disappear following evacuation of the fluid

Wever[35] recently commented upon the effect of fixation of the ossicular chain by fluid, saying, "When it comes in contact with the drum membrane and ossicles this substance (fluid and semifluid substance) dampens and loads their movements, and when finally it fills the cavity it adds stiffness as well The result is an impairment of sensitivity that in the early stage affects the high tones the most seriously, and then in the severe stages includes all tones."

The next step usually recommended, if one is not certain of the presence of fluid, is the diagnostic inflation using a catheter and diagnostic tube. Many auscultatory sounds have been described in detail by Hoople,[1] Hotchkiss[21] and others, and need not be repeated here. As one becomes more accustomed to recognizing the drum with fluid behind it, the necessity for diagnostic inflation diminishes, unless, of course, the drum is opaque. The author is in agreement with Eagle[14] that it is preferable to avoid using the Eustachian catheter if at all possible because of its traumatic effect upon the pharyngeal orifice of the tube and the risk of prolonging the disease

If one suspects fluid in the tympanum, a diagnostic paracentesis may as well be done initially if the symptoms justify it, the indications being the same of course, as though one had no doubt about fluid being present. This can be done without anesthesia with a short bevelled needle attached to a tuberculin syringe or in the usual manner with a knife. If fluid is encountered upon suction or Politzerization, the opening must be enlarged as for treatment purposes, particularly if the fluid is of the thick mucus type One can usually foretell the nature of the fluid by the appearance of the drum When the fluid is serous, the drum is more apt to be thin and transparent, with an amber or yellow color When thick mucus is present the drum has a more reddish hue with a dispersed light reflex, *i e*, more of a sheen on the surface, and it is less transparent

Having established the presence of an effusion in the ear, one must then search carefully for its cause If the etiology is not apparent in the nose, sinuses, mouth, nasopharynx or neck, one should enlist the aid of an internist who is in a better position to discover possible systemic disorders

Cytologic study of smears of the ear fluid will often give a clue as to whether the etiology is inflammatory or noninflammatory by the number of polymorphonuclear cells present

PROGNOSIS

With regard to prognosis, most observers agree that the longer the condition has persisted prior to treatment, the less favorable the chances for a complete cure

Ears containing a small amount of fluid respond to treatment more promptly than those which are full The mucus type of secretory otitis media is more often resistant to treatment than the serous type, probably because there is a low-grade inflammation of the mucous membrane of the Eustachian tube and tympanum, and these changes become irreversible after a variable period of time Those patients with a blue discoloration of the drum are usually more resistant to treatment Patients in whom one is unable to find any definite etiologic factor have much less chance of getting well, although they may do so spontaneously if and when the unknown pathology subsides

Why some ears develop adhesive processes after a relatively short time and others continue to harbor fluid for many years without forming adhesions is not known We do know that the fluid coagulates readily when exposed to air, and it may be that when fluid remains in the tympanum after the Eustachian tube becomes patent, it then coagulates and tends to form adhesions We should, therefore, continue treatment as long as any fluid remains in the middle ear

In the vast majority of cases, the hearing returns to normal after the fluid is evacuated, regardless of the number of myringotomies, unless there are adhesive processes or preexisting inner ear pathology

TREATMENT

There are two objectives in the treatment of otitis media with effusion, namely, to rid the middle ear of fluid and to prevent its recurrence by treating the associated etiologic condition if this can be determined The preservation of normal hearing is the most important objective, but this will be attained if the ear is kept free of fluid and adhesive processes are thereby prevented

The first objective is much more easily accomplished than the second, and unless we are able to make a correct etiologic diagnosis we are almost sure to fail except in the acute cases of recent onset, which have a fair chance of clearing up spontaneously

The treatment varies somewhat with the duration of symptoms, the quantity and type of fluid present, and the cause of the tubal obstruction

Cases with symptoms of short duration, such as an aero-otitis media with effusion or those with an associated acute inflammatory condition in the nose or throat will often subside after proper attention to the acute nasopharyngitis or sinusitis, perhaps combined with subsequent Politzerization after the nose and nasopharynx are free of pus.

In the absence of a coexisting acute inflammatory condition in the nose or throat, if there is only a small amount of fluid present and the hearing is not markedly impaired, one is usually content with trying Politzerization alone for a week or so, but at the same time searching for and treating the cause of the tubal obstruction

If the tympanum is full of fluid, as is the case more often than not, or if the history indicates that the fluid has been present for a week or longer, one may as well proceed with myringotomy at the first visit, except in children with nasal allergy or infected hypertrophied adenoids These children's ears will clear up only when the allergy is controlled or the obstructing lymphoid tissue removed by one method or another

The myringotomy incision is usually made along the inferior half of the drum, and as long as possible, with the hope that it will remain open for a week or so, however, it usually heals within 48 hours, which is much too soon The myringotomy is then repeated as often as the fluid accumulates

Having opened the drum, we have a choice of several methods of forcing the fluid from the middle ear, namely, Politzerization, catheter inflation, suction applied to the external canal with Siegel's otoscope, spot suction, or a combination of these The author has learned by experience, as did Politzer,[2] Eagle,[18] Hotchkiss[21] and others, that catheterization inflicts too much trauma on the orifice of the Eustachian tube and probably prolongs many cases that might have cleared up promptly had the catheter not been used I have seen several patients with symptoms of brief duration and with little or no visible swelling about the orifice of the tube on first examination, who, after several catheterizations, were observed to have definite edema of the orifice and then ran a protracted course Since this observation was made, I have used Politzerization and suction exclusively to remove fluid after myringotomy Catheterization for auscultation is sometimes necessary to establish a diagnosis of fluid in the ear, in which case the beak of the catheter should be placed gently under direct vision with a nasopharyngoscope

If the fluid is of the thick mucus type, the incision in the drum is made longer and spot suction is applied simultaneously with Politzerization to prevent the mucus mass from being drawn back into the tympanum as soon as the positive pressure has ceased and the intratympanic negative pressure again prevails The placing of a pledget of cotton against the myringotomy opening to absorb the serous and seromucoid fluid as it is forced out also aids in evacuating the fluid more effectively After one has emptied the tympanic cavity as well as is deemed possible at one sitting, a pledget of cotton left in place against the drum will usually absorb additional serous fluid as it subsequently drains from the mastoid cells into the tympanum

Having evacuated the fluid from the middle ear, one must not forget to treat the primary condition responsible for its presence Local conditions in the nose and nasopharynx which might act as influences toward recurrence should be corrected

Jordan[17] employs a trial period on antihistaminics if the etiology is not established and when allergy is suspected

Jones[8] reported good results with the use of an autogenous vaccine made from culture of the nasopharynx in a few chronic recurrent cases The author has had no personal experience with vaccines in the treatment of this disease

The use of a permanent perforation in the drum has been advocated by some and condemned by others. Hotchkiss[21] believes that it is justified in selected cases which do not subside in spite of corrected causative disease especially in older individuals in whom a perforated drum is of little concern (He uses a corneal trephine on a long handle to make the permanent opening)

Mastoidectomy has been performed as a last resort by several authors in chronic resistant cases Although this writer has performed a mastoidectomy on only one patient with secretory otitis media, he has formulated the following opinion regarding the type of case most suitable for operation *1* a chronic secretory otitis media resistant to all other forms of treatment, *2* with corrected or with no apparent associated nasopharyngeal or sinus disease, *3* with an inflatable Eustachian tube, *4* responding temporarily to myringotomy and inflation, indicating that the hearing loss is not irreversible, and *5* with a fairly well pneumatized mastoid. Conversely, there would be little or nothing to be gained by operating upon a sclerotic mastoid upon a patient whose Eustachian tube is noninflatable, or upon a patient whose hearing does not return to a useful level at least temporarily after evacuating the fluid

RESULTS OF TREATMENT

Considering the series as a whole, the results of treatment were fairly satisfactory As mentioned earlier in this paper, there were 183 patients whose symptoms lasted from a few days to three weeks, 90 patients who were well after three to six weeks, and 99 whose disease persisted longer than six weeks The total of 372 patients had a total of 439 separate attacks Forty-six patients had from one to 16 recurrences

Although a total of 449 myringotomies were done, 104 patients in the acute and subacute groups became rid of the fluid without myringotomy This number does not include 28 children in all categories whose ears returned to normal without myringotomy following adenotonsillectomy Another 115 patients in the acute and subacute groups returned to normal after only one myringotomy, 31 2 per cent of the total had bilateral involvement

Considering only the group of 99 chronic cases, the results were more disappointing Of these, 52 were eventually declared well and 18 improved Another 18 were not improved after prolonged treatment, and there was insufficient follow-up observation in 11 patients Two of those not improved had lymphoepithelioma of the nasopharynx

The results in 45 patients in the chronic group treated by various methods for hypertrophied lymphoid tissue about the Eustachian orifice are shown in Table 4

The author discontinued using the radium applicator several years ago, but it seems that the immediate results in this small group were essentially the same as with external irradiation Several of those who did not respond to irradiation were later found to have an allergy as the primary etiology

Of the 11 patients with chronic secretory otitis of allergic etiology, four became free of fluid while receiving injections of dust and mold extract, three improved on allergic management before they discontinued treatment, and two showed no improvement with antihistaminics or specific therapy The remaining two patients in this group were of interest in that they may well be *classified as belonging* in the category of

TABLE 4

RESULTS OF TREATING HYPERTROPHIED LYMPHOID TISSUE IN NASOPHARYNX, IN 45 CHRONIC CASES

Method of Treatment	*Total no treated*	*Number cured*	*Not cured*
Radium applicator	15	8	7
External irradiation	9	5	4
Adeno tonsillectomy	22	19	3
	46*	32	14

One of those not improved after adenotonsillectomy later cleared up after external irradiation

intrinsic allergy with perhaps an autonomic dysfunction and arteriolar spasm as the underlying pathology In any case, they both responded to vasodilator drugs after being resistant to all other forms of treatment. Their case histories are summarized as follows

Case 1 Mrs. L. W., age 51. Complained of roaring and fullness in left ear vertigo and throbbing pains in left temporal and parietal regions daily for two weeks following a cold." The left drum was retracted and amber in color Rinne negative. Serous fluid was evacuated on myringotomy and inflation. The nose sinuses nasopharynx and Eustachian orifice appeared essentially normal The fluid recurred after a few days when myringotomy and inflation was repeated and an antihistaminic prescribed. She continued to have recurrences of fluid and left sided headache and during the ensuing six weeks five myringotomies were done. An X-ray of the mastoid revealed "moderate increase in density of the air cells of the left mastoid with some haziness of the cell walls. No bone destruction Findings are consistent with an acute or subacute mastoiditis left." The X ray changes were of course due to the presence of serous fluid in the mastoid air cells. Nasal smears were negative for eosinophiles. Two months after the initial visit she still had fluid in the ear and almost daily attacks of left-sided headache which seemed to be similar to histamine cephalgia. She was given daily subcutaneous injections of 1 100 000 histamine and after four days the headache did not recur The fluid in the left ear was blown out once more at this time. Histamine injections were continued and subsequent examinations over a period of two months showed no recurrence of effusion in the middle ear Hearing returned to 15/15 for whispered voice

Case 2 Mrs J F K, age 49 c c Fullness in both ears and impaired hearing for 10 days Two inflations elsewhere with very temporary improvement. History of occasional hay fever in the past but no associated symptoms at time of onset of ear trouble Both drums retracted with serous fluid in tympanic cavities Eustachian orifices edematous Nasal mucosa slightly paler than normal, sinuses and nasopharynx negative Nasal smear and ear fluid negative for eosinophiles W B C normal. Pyribenzamine was prescribed empirically On Politzerization air traversed the right Eustachian tube but not the left. During the following two and one-half months the drums were incised many times and fluid aspirated but each time the ears became full again within a few days. The Eustachian orifices remained slightly edematous Further investigations had been carried out including skin tests which were all negative. The B M R was minus 17 and the blood cholesterol was very slightly elevated On the strength of this thyroid extract was prescribed by the internist without improvement A food allergy was then suspected but there was no improvement on a nonallergic diet A culture of the nasopharynx revealed hemolytic streptococci and an autogenous vaccine was ordered but never used While the vaccine was being prepared several bits of tissue were removed from the nasopharynx for biopsy that were negative for malignancy Then one day the patient presented herself with an edematous swelling of the left upper eyelid This suggested the possibility of arteriolar spasm and capillary dilatation as the cause of the edema She was started on niacin 100 mgm t i d before meals Both drums were opened, with evacuation of a large quantity of serous fluid There has been no recurrence of fluid for a period of six weeks

Both patients had associated signs of vasomotor or autonomic dysfunction — a vascular headache on the homolateral side in Case 1, and an edema of the eyelid and a history of extreme sensitivity to temperature changes in Case 2 The response to the histamine desensitization and to the niacin may have been coincidental, but the evidence seems more to the contrary A longer period of observation is needed before any definite conclusions can be drawn

SUMMARY AND CONCLUSIONS

1 The available literature pertaining to the subject of secretory otitis media has been reviewed and the author's series of 372 cases analyzed with regard to etiology, pathology and treatment

2 The apparent increasing frequency of this disease is largely due to increased vigilance on the part of otolaryngologists during the past decade, and to a lesser extent due to the influence of widespread use of antibiotics The rôle of virus infections (in the etiology of this disease) has not been satisfactorily determined

3 A scattered survey of the incidence in various parts of the country suggests that secretory otitis media occurs much more frequently in areas of low altitude with a high relative humidity

4 Upper respiratory infections are the chief predisposing causes in adults as well as in children Hypertrophied lymphoid tissue in the nasopharynx plays an important rôle in children Allergy accounted for 10 per cent of the entire series and 11 per cent of the chronic cases

5 Differences in the thickness of the tympanic mucosa and variations in capillary permeability may be deciding factors as to which ears with an obstructed Eustachian tube develop effusion and which ears do not. Autonomic dysfunction can adversely affect capillary permeability

6 Normal variations in the size of the isthmus of the Eustachian tube may explain in part why some ears become chronic and others do not under similar circumstances.

7 Some middle ears continue to harbor fluid after the Eustachian tube has become patent. The secretion in these ears is usually of the mucus type, the result of continued low-grade inflammation of the mucosa which probably has undergone metaplasia.

8 Protein determinations on the ear fluid of a limited number of the author's patients does not support the view that the serous fluid has a high protein content or that the mucus fluid has a low protein content Wide variations were found to exist in similar types of fluid Comparative studies of the gross appearance of the fluid the cell count, and protein content showed that thin serous fluid usually had a low cell count and low total protein, however, no definite pattern could be established Further comparative study of a larger number of such determinations is indicated

9 Eosinophiles rarely occur in the fluid of secretory otitis media, even when the tubal obstruction is the result of allergy An eosinophilia was not observed in any of the more than 50 slides examined

10 The Eustachian catheter should be used as gently and as sparingly as possible in the diagnosis and treatment of this disease as the trauma inflicted on the pharyngeal orifice of the tube undoubtedly prolongs the course of the condition

11 Mastoidectomy should probably be done more often on the chronic resistant cases to preserve hearing The author has expressed his opinion as to the type of case best suited for mastoidectomy

12 The vasodilator drugs may prove useful in the treatment of this condition if there are associated signs of autonomic disorder Two cases are cited in which they were seemingly of therapeutic value

13 Secretory otitis media remains one of the greatest problems in otolaryngology today, but this fact is still not appreciated by many

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NASAL SINUS DRAINAGE

Factors Which Influence Bernoulli Action*

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INTRODUCTION

The author has written three previous articles on Bernoulli action in the nose in which he has attempted to show various mechanisms whereby blowing of the nose produces suction at the sinus ostia [1-3] The present paper is a discussion of various factors which influence Bernoulli action

We should hold in mind throughout this discussion that we are not considering air currents in normal or even in forced respiration, nor are we concerned with the atrophic nose or even with a normal nose with wide breathing space At the moment, we have no interest in what pattern a puff of smoke will make in the nose of a cadaver

Our remarks at present are strictly limited to *forceful expirations* through a *congested nose* There is another fact which we should keep in mind The constriction of the air space of the nose to which we shall refer is caused by swelling of the turbinates The turbinates are composed of erectile tissue and erectile tissue in the nose is just as unpredictable and irresponsible as erectile tissue found elsewhere in the body This explains why the Bernoulli effect is so variable when we blow our noses Thus, when recovering from a head cold, one may blow his nose without result and a few seconds later blow it with very satisfying productivity

I — Conformation of Residual Air Space in Nose

If the nose is congested to such an extent that there is only a small air passage through it, we are interested only in the

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hape of that residual air passage If this remaining air passage is comparatively straight and is of an equal caliber or bore throughout its length, we can expect no Bernoulli effect. On the other hand, if this air passage is constricted anywhere along its entire length, there will be increased velocity of air at the constriction and diminished pressure in that area when one blows his nose. If a nasal sinus ostium is located in the area of constriction of this residual air passage, it is subjected to Bernoulli action when one blows his nose

It is difficult to conceive of a conformation of this residual air space which can produce suction simultaneously at all ostia which open into it. It is equally difficult to imagine a constricted air space which does not produce suction at at least one ostium along the line.

II — Residual Air Space in Sinuses

Throughout this paper I have intentionally avoided frequent use of the term "suction" as applied to Bernoulli action This was done in an effort to have us keep in mind that the only force which can be employed in forcing mucus through the ostia into the air stream is the pressure of the air in the sinuses. Regardless of the actual air capacity of a given sinus, this air capacity may be encroached upon by swelling of the soft tissues within the sinus and by the accumulation of mucus or pus within the sinus. So in a nasal sinus, the only effective air capacity is the residual air space.

Let us assume as we did above, that the ostium opens into a constricted portion of the residual nasal air passage into an area of diminished pressure. On blowing the nose, we start off with approximately atmospheric pressure of the air in the sinus, which pressure rapidly diminishes as the mucus is forced through the ostium This motion of mucus continues until the pressure within the sinus is no greater than the pressure in the nasal air passages or until the mucus bubble bursts. On the termination of the blow, atmospheric pressure re-establishes in the sinus. When mucus is again condensed at the sinus ostium by ciliary action, we have proper conditions for a repetition of the process.

III — Patency of Sinus Ostia

It stands to reason that, if a sinus ostium is solidly blocked by soft tissue swelling, it is incapable of transmitting any Bernoulli effect to its sinus This is true whether the blockage is in the ostium proper or whether the obstruction is caused by overlying turbinate edema It is possible, however, for soft tissue to overlie the ostium in such a manner as to block its normal opening into the air space but allow it to communicate with the residual air passage of the nose at a more proximal or distal position In such a case, this fissure or slit serves as an adventitious ostium and, if it is located in an area of air space constriction, it will act like a true ostium as a pathway for Bernoulli action

If an ostium is blocked with mucus, it does not preclude Bernoulli action As we shall discuss later, such a condition is ideal for productive Bernoulli effect

IV — Viscosity of Mucus

The mucus can be so thick that there is difficulty in forcing it through the ostium On the other hand, it can be so watery that the cilia cannot condense it at the sinus openings

In the first case, more force than usual is required to force the mucus into the air passage In the latter instance, Bernoulli action is ineffective for the simple reason that it cannot grasp the mucus to remove it

V — The Force Which One Employs on Blowing His Nose

Some years ago, when I was afraid that some Bernoulli critic would object to my drawn glass tubes which I used to represent constrictions in the nasal air passages, I resorted to a straight glass tube with a tap in the middle to represent a sinus ostium

Into the straight tube I inserted two rubber dam tubings filled with water The ends of this tubing were pulled together on the outside of the glass tube and tied in position on either side of the tap The rubber tubing inside the glass tube, being distended with water, encroached on the air space and fairly represented a nasal constriction formed by apposition of turgescent turbinates

I attached a water manometer to the tap and blew through the glass tube. I found that when I blew lightly there was a slight amount of suction, but when I blew forcefully, the manometer registered pressure This puzzled me for a long time until it was finally explained to me by one of my engineer friends who noted that when I blew with force through the tube the soft rubber and water constriction moved distally

Thus, it is conceivable that on blowing the nose one may get suction at a given sinus ostium when he blows lightly and get no suction at all when he blows harder because of the fact that he distorts the congested turbinates and moves the area of constriction anteriorly

The opposite effect of varying air pressure on blowing the nose is illustrated by the following experiment

Push a close fitting rubber tube into a straght glass tube which has one middle tap Adjust the rubber tube so that it comes up close to the tap Blow gently through the rubber tube A manometer attached to the tap shows suction

Continuing to blow lightly through the rubber tube, withdraw it gradually until no suction registers on the manometer Now, holding the tube in the same position, blow forcefully Again the manometer registers suction.

The change in Bernoulli effect due to the force exerted probably explains the fact that an accomplished nose blower has a repertoire which varies from a light zephyr to a trumpeting blast.

If the constriction is distal to the ostium reversal of the air flow by sniffing may produce effective Bernoulli action

VI — Condensation of Mucus at Sinus Ostium by Ciliary Action

We will take as an example one of the maxillary antra which has accumulated a considerable amount of mucopus on its floor We will assume that its ostium opens into the middle meatus at the most constricted portion of the residual air space of a congested nose The ostium is patent and mucus on the floor of the antrum is of the ideal viscosity for forcing through the ostium.

We might think, with the above mentioned favorable factors, that all conditions will have been met for a productive nose blow, but there has been no condensation of mucus at the sinus ostium, and the blowing of the nose will result only in a momentary rarefaction of the air in the sinus and will be entirely unproductive

How can the mucus be brought to the ostium? I know of only four mechanisms by which this can be accomplished *1* we might tilt the head so that mucus reaches the ostium by gravity, *2* the antral mucous membrane may swell and bring the mucus up to the level of the ostium, *3* we may have increased secretion which brings the level of mucus to the ostium, *4* the cilia of the antral lining may walk the mucus along the floor and walls to the sinus opening Certainly there is no disagreement in the opinion that ciliary action is the most important mechanism for transporting mucus and condensing it at the sinus ostium This condensation is an absolute requisite for productive Bernoulli action

What I am about to say is purely conjectural, but I believe that, when the cilia have condensed the mucus at the ostium and the mucus has formed an air seal in the ostium, as the cilia further attempt to push it into the nasal air passage there is produced a slight diminution of air pressure in the sinus which serves as a stimulus for a sneeze or a nose blow

If the ostium happens to be in a pressure area of the residual air space, air will bubble through the mucus into the sinus and re-establish equalization of pressure If, on the other hand, the ostium is located in an area of diminished pressure, the mucus is forced out into the nasal air passage by the air in the sinus until the bubble of mucus breaks Thus, on the completion of the blow, atmospheric pressure is re-established in the sinus So, no matter whether the sinus ostia are located in areas of pressure or diminished pressure, nose blowing or sneezing tends to produce equalization of pressure in the sinuses

CONCLUSIONS

In this paper we have discussed the various factors which influence Bernoulli action in drainage of the accessory sinuses of the nose. We have seen that all of these factors are variable and this very variability explains why the productiveness of a given nose blow is unpredictable

All of the favorable factors necessary for effective Bernoulli action are likely to be present in a moderately congested nose, and it is only on occasions of nasal and sinus congestion that such action is desirable. There is no necessity for draining a sinus which is empty

Of all the factors which influence Bernoulli action, only one can be readily controlled voluntarily that is the timing and force which one employs in blowing his nose.

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THE
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THE 1952 HERBERT STANLEY BIRKETT LECTURE, A CRITIQUE OF PRESENT DAY METHODS OF HEARING TESTING *

D E S WISHART, M D,
Toronto, Canada

We are assembled to honor the memory of a name great in the medical annals of McGill University, Montreal and Canada To those responsible, I express my sincere thanks for inviting me to deliver the 1952 Herbert Stanley Birkett Lecture

Those of you who have read the admirable obituary, penned by your own Dr W J McNally and published in the *Annals of Otology, Rhinology and Laryngology* in 1942, will be astonished at the multitude of Dr Birkett's activities and accomplishments. He was a truly amazing man and his success, phenomenal Unquestionably, he is one of whom you must always be proud

I had the pleasure of being in his company many times, for he was a close friend of my father They were at McGill at the same time, in medicine, and in the same fraternity They were alike in their hatred of what their consciences knew to be wrong Dr Birkett jealously guarded and upheld the integrity of otolaryngology To me he was a shining example of what a courteous gentleman should be I remember him most for the way he seemed to consider charitably that some of my faults were prompted by better motives.

Read at McGill University Montreal, Canada, April 25 1952

Editor's Note This ms. received in Laryngoscope Office and accepted for publication, June 15 1952.

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He was a very great Canadian doctor and I deeply appreciate the honor of delivering the lecture by which his name is perpetuated

* * * *

Ever since the teaching of medicine commenced in Montreal the name of McGill University has been world famous Some of the hospitals in this city are now about to tear down the buildings which have served them so well and are engaged in planning that the new structures shall be worthy of the great traditions of the past

One of the problems which you as otolaryngologists must settle for good or ill is how you shall plan for proper attention to hard-of-hearing adults and children

Hearing Testing Unsettled

The testing of hearing is in a muddled state

The formerly accepted tests of hearing have been proved so inaccurate that they have been abandoned almost everywhere In their place came the pure-tone audiometer for a time, but it has now become apparent that it is impossible from the study of an audiogram to determine how well a patient hears speech The result has been the re-establishment of measured speech-hearing-testing

In the enthusiasm for this, certain great hospitals have set up establishments for testing hearing which are costly and complicated The claim is made that the many elaborate tests thus made possible provide information of value There is, however, another side to the picture

In certain of these hospitals only a very few technicians — in some only one — can or are allowed to run the audiometers and use the soundproof room, the examinations are lengthy and may take five hours or more to complete, and they are fatiguing to the patient The reports issued are couched in such terms that few if any of the attending staff can understand them, it is rarely claimed that they can be used for comparison with results obtained on other occasions, and to crown all — some of the government boards to whom these elaborate reports are made for purposes of determining pensions, etc., completely disregard these audiological findings and base their decisions on unmonitored conversational voice

In what follows I hope to convince you that certain prevalent fashions in the testing of hearing are wrong and to indicate certain other things which are essental

Purposes of Hearing Tests

Hearing tests are performed for nonmedical as well as for medical reasons Examples of the former are — the determination of the suitability of employees for certain jobs, the effect of workshop noise on the employees, the screening out of the school children who should be referred to a doctor, etc. These can be performed by technicians or by the specially trained technician — the audiologist

On the other hand, hearing tests for diagnosis, prognosis and evaluation of treatment should be performed by the otologist. For he serves patients who wish to know why their hearing defect exists, what the future holds for them and what can be done to alleviate the impairment. The main essential of a hearing test is measurement.

Otologist Squeezed Out by Audiologist

Even as short a time as 15 years ago there were few ear, nose and throat clinics where there was any provision whatever for the testing of hearing, the few hospitals where an attempt was made to provide proper facilities were distinctive because of such provision. Now, however, great changes have occurred, and there are many cities where one or more hospitals provide suites of rooms exclusively set apart for the testing of hearing with elaborate nearly soundproof rooms, great installations of expensive audiometric equipment and a staff of trained technicians headed by an audiologist. These elaborate schemes have arisen from the belief that the testing of hearing is passing from the hands of the practicing otologist and will be confined strictly to expensive hospital departments devoted to the testing of hearing

In many of these a considerable hospital distance separates the hearing suite from the otologic clinic In some there are peculiarities such as the following visits by any otologist may be infrequent, the hearing establishment may be run exclusively by the audiologist, his special assistants, his technicians and his nurses, in the ear, nose and throat clinic there may be no provision whatever for the testing of hearing by the clinical otologist, and the latter may depend entirely upon the reports sent from the audiological department

The testing done in some of these departments is most elaborate and time-consuming — so much so, that in very few is there one attending otologist who is capable of performing the tests and in the majority there is no otologist who could afford the time involved

Audiological Work-Up Tests Without Validity in a Clinic

Many new hearing tests have been described and some of them strongly supported Every audiological clinic has a formidable list of tests

Guild[2] says "At least 10 to 12 hours of time per patient would be needed to administer all the hearing tests now regarded by one or another investigator as of interest and value The apparatus to make possible the administration of these tests would cost a minimum of several thousands of dollars This figure does not include the cost of the special rooms needed for satisfactory use of the testing apparatus, nor does it include the salaries of specially trained technicians to use the apparatus, or payments to skilled electronics engineers to keep the various pieces of apparatus in proper operating condition"

The supposition that these tests are of clinical value is not correct

In a lawsuit a physician stated he had done all the tests This drew the sage retort that a medical man who would do all the tests would be either naive or unscrupulous A wise and skilled medical man should perform only those tests which he knows will add to the knowledge of the patient's troubles, which are reliable and which are valid

Knowledge of any part of the body is based upon a correlation of function with the gross and microscopic appearance Real knowledge regarding hearing defects depends upon evidence from innumerable cases for which there has been adequate history, painstaking examination, accurate hearing tests, plus descriptions of the gross and microscopic pathology

The amount of such material available for critical study is not great and few teaching centers possess any whatever The evidence from a very good source of information is that 'histopathological evidence does not exist to support any of the hypothetic interpretations that have been proposed as explanations between functional differences observed in the fitting of hearing aids on persons with otherwise similar degrees and types of deafness "[2]

Guild[3] has written three condemning paragraphs which have not been controverted

"The information obtained from the elaborate tests or batteries of tests is primarily of research interest. Until the significance of the data obtainable by these tests has been evaluated in terms of lesions that otherwise would be overlooked or in terms of therapy that otherwise would not seem indicated clinical otologists should not be urged to use them or made to feel they are out of date if they do not.

In other words it is time for a clear distinction to be made between tests for research purposes and those for clinical purposes Nothing is gained clinically by the making of hearing tests that cannot be interpreted with reasonable certainty in terms of causative lesions

'All too often, a diagnosis, so-called, amounts to nothing but a statement of the kinds of hearing defects found by the tests made Such a statement no matter how elaborate the battery of tests used or how detailed the report of the data obtained is merely a description and not an interpretation of hearing tests and has no medical usefulness whatever

The establishments which I have criticized have a place in any institution devoted to research into problems of hearing and of psychology, but are unnecessary in a doctor's office or in a hospital clinic In these, there should be facilities which provide data that may be used for the good of the patient and the information of the otologist A hospital clinic may have a research unit attached to it, but, as this unit cannot provide the information which the clinic and the otologist require, it is not necessary for hospitals to provide it, unless the hospital can afford the extravagance of personnel for a research program

Interference with Clinic Is Wrong

A great research unit and its personnel must not be allowed to interfere with the necessities of the hospital clinic

Essentials for a Clinic

The essentials of a satisfactory method of mechanically measuring the hearing are — accuracy, quickness, and a technique which can be exactly repeated at a later date The apparatus should be as simple as possible, rugged, not likely to get out of order, and constant in performance

Restoration of Otologist to His Proper Function

I believe that the hearing facilities should be in the ear, nose and throat suite and that they should be such that any of the attending staff — providing he trains himself to operate the machines — can, when he desires, test the patient in whom he is interested I do not believe that the day of the otologist is over

Plan at the Hospital for Sick Children

We have tried to provide such conditions at our new hospital in Toronto in the following way

Our out-patient clinic has been so designed that the entire suite of rooms is at the service of the Hard-of-Hearing Clinic every afternoon Certain of the rooms are available to the Hard-of-Hearing Clinic every morning

The suite consists of five examining and treatment rooms, a hearing clinic room with an adjoining observation gallery, a hearing test suite consisting of an anteroom and two nearly soundproof rooms, a research room, a secretary's office, an office for the chief of service and a small waiting room

Our work roughly consists of the following interviewing the parent, the taking of an adequate history, the physical and special examination of the patient, the estimation of the patient's hearing, and if treatment is possible, the provision of this treatment. Whether treatment is feasible or not, the parent is given detailed advice regarding the home care of the child, and the patient is referred to the best available educational instruction

The work is carried on by two members of the staff, three Fellows, a secretary and the chief of service. We expect to obtain an experienced teacher of the deaf

The clinic has been placed next door to the social service department and across the hall from the department of psychological medicine and the speech clinic, with all of whom we work closely in the follow up of our patients

Our hardest problem is the testing of the hearing of children 12 months to three years of age In the hearing clinic room, little children who are extremely hard-of-hearing are examined with special testing devices These are the Peep Show, the Melody Master and various game-methods

Our Peep Show was evolved from the thumbnail sketch which accompanied an article by Dix and Hallpike[3] in the *British Medical Journal,* Nov 18, 1947 From that we built an apparatus which would produce a sound when a child was looking at a picture through a peephole and provided a screen, behind which the apparatus and the operator of the machines were hidden. This original model required two or more workers to handle the machine and child

During the evolution of our final model I visited Dr Norton Canfield, of New Haven, and received his generous help I did not copy his machine but I did adopt his excellent idea of centralizing all the mechanism on one control board Only one operator is required to handle our machine and the patient.

In this Peep Show we can use either a colored movie or colored still pictures We find that the movies captivate most of our little patients, but occasionally a very timid child has to be tested with our set of still pictures

Our second device for interesting children in sound is a Melody Master, which consists of a gramophone, headphones and microphones The children gradually are persuaded to wear earphones through which they hear any gramophone record which suits our purpose The mother assists by using a duplicate set of headphones and by endeavoring to speak to the child through a microphone The method is of only slight value at the initial visit but is very useful after the child has been attending for a number of weeks It is a pleasurable way of teaching the child to use earphones, for until this has been achieved the child cannot be tested with our speech audiometer

A much smaller portable microphone and headset is available for demonstration to parents who desire such apparatus for use at home in the instruction of their child

We have also many animal toys and peg-toys which can be be used to demonstrate to the mothers game-methods of conditioning their little deaf children to various sounds All of these games are similar in their basic purpose, which is that by means of a slight reward the child learns that a funny stimulus it receives (namely, sound) has a meaning

These four schemes arouse no antagonism or fear The time consumed in testing is sometimes great, but in the end it is rewarding

Special cupboards contain toys for the amusement of the children and the various forms of printed advice for the guidance of parents Gradually we hope to acquire such a number of pamphlets and forms that we can meet the problems of any parent

We advise parents of very young children to take the correspondence course of the Tracy Clinic

Hearing Test Suite

Two heavy doors make the hearing test suite soundproof except for very extreme noises Ordinary noises in the adjoining rooms and halls and outside do not in any way interfere with the patient or examiner

Two windows of unique construction look from the anteroom into the hearing test rooms Through these an observer in the anteroom can see all that is going on in the hearing-test room without those inside being aware that they are being observed

This has great value in allowing an observer to learn how various hearing tests are performed, and a parent to see exactly how its child is being handled, without the child being distracted by the person in the anteroom

The first hearing-test room has in it a double set of instruments One set, consisting of a high-fidelity gramophone audiometer and a pure-tone audiometer, is for the use of the clinicians. The second pure-tone audiometer and a much less expensive gramophone audiometer are for the use of the young doctors who are learning how to do hearing tests Masking is always used

The second hearing-test room is smaller than the first and contains two instruments a pure-tone audiometer and a special gramophone audiometer These are for the use of the chief of service and his assistant.

We use three types of audiometers The pure-tone audiometers are the last designed by the Western Electric Company They are the best of their type and are known for their simplicity, reliability and durability The special gramophone audiometers are instruments of unusual fidelity and were specially designed in Prof Solandt's department in the School of Hygiene, Toronto They are simple and accurate and full directions are provided so that any member of the clinic can operate them These machines probably will be able to play any type of gramophone record which may be devised The third machine is the Baldwin Gramophone Audiometer, — a recently marketed elaboration of the old 4-A Audiometer

In our research room, we have a duplicate of the Johns Hopkins' skin resistance machine for the testing of the hearing of young infants One of our Fellows is engaged in a three year investigation of the Baltimore claims

All of these physical facilities are close to rooms where every type of clinical examination and treatment is available The otologist who is to examine and treat the child and advise the patient is expected to attend every step For the child must learn to trust him implicitly

Statements Regarding Techniques

Now I must direct your attention to certain details regarding technique which we find of great importance in the testing of children's hearing

Re Pure-Tone Testing

To obtain results when testing the hearing of a very young child, the child's apprehension must be removed, his interest aroused and his cooperation obtained and held

This is difficult to achieve when using the pure-tone audiometer, — for the child has little interest in pure-tones

The commencement of pure-tone testing is done with the Peep Show It is an invaluable first approach The child can operate it without instruction. The picturesque little house at once disarms the child's fears and arouses his curiosity He naturally looks into the doorway — but he sees nothing for the black hallway is in darkness, however, what is a doorbell button for but to be pressed? The result is a pleasant discovery A picture appears which is moving The moving pictures of farm activities are pleasing and have dramatic attention holding appeal The desire to see what comes next keeps the child's cooperation. When his little arm is too weak to press the doorbell button the patient can rest his arm on the ledge and press the doorstep

Over the doorway is a small red fanlight and behind the gable decoration is a loud-speaker When the child presses the button a flashing light appears in the former and from the latter comes a musical tone synchronous with the flashing light. The light and the sound can be altered at will by the operator

Four discrete frequencies—500, 1,000 2,000 and 4,000 c.p s —are provided The rate can be varied and also the relative lengths of the off and on periods

In this test the child learns that when he responds to the flashing light by pressing the button he is rewarded by a continuation of the pleasing moving picture and also that when the light is not flashing, pressing the button produces no picture.

While this lesson is being learned, the operator is experimenting with different intensities of the four available sounds The control board can be operated without the child s being aware of it. Sometimes the child will suddenly investigate the gable, thus betraying the fact that he has located the source of the sound Sooner or later the operator switches off the light and in a favorable case the child continues to press the button whenever the sound is being produced

The child has discovered that a certain peculiar sensation has a meaning, that, if, when he perceives that sensation, he presses the button, he will get the reward of more pictures The pleasure the child gets is evident to all the observers and frequently brings tears to the eyes of the mother, who up to that point has believed her child could not hear The child has discovered that sound has a meaning and hope has been kindled in the mother's heart

The doctor, on the other hand, has formed a rough idea of the degree and extent of the hearing loss by having observed the intensity of each note that has reached the child's intelligence A very rough audiogram for four tones can be obtained in some cases

This happy result can be the early stage of pure-tone testing for the little patient If we had proceeded differently and had introduced the child to the pure-tone audiometer we would probably have aroused resentment and fear, for a child is not attracted by the uninteresting sounds of a pure-tone audiometer

To keep the child's attention it is necessary that there be as few distractions as possible As a rule, no one else is in the room except the child and the otologist, however, it is often necessary that the mother sit beside the child Observers are accommodated in the observation gallery where they can hear and yet are not seen

Testing Older Children with Pure-Tone Audiometer

We do not attempt testing a child with the pure-tone audiometer until much later in its clinic life We do not use it until the child's fears have been eliminated, until it trusts and obeys its instructor

In using the pure-tone audiometer we have given up having the patient press a button The action is distracting and takes time We have the child raise his finger when he hears the tone and drop it when the sound ceases The child sits with his back to the examiner and the latter watches the action of the finger and from it judges his patient's interest, attention, cooperation and alertness

We bother not at all with speech tests performed with selected test lists designed to show up losses of hearing in different parts of the frequency range The best way to test frequency hearing is to use frequencies as stimuli. One cannot infer what speech hearing is from an audiogram

We make all tests very short. The time cannot be stated exactly A young child ought not to be in the soundproof room longer than a few minutes at a time Loss of interest on the part of the child will be shown in the gradual drooping of the signal finger, the delayed response of the finger, the swinging of a foot, etc As soon as the child's interest or cooperation flags, we stop the test and leave the room

Re Speech Testing

Our testing of speech is simple. We are not convinced that any of the newer and more elaborate methods of using speech in the testing of hearing are applicable to as wide a variety of patients as is the simple phonograph test

We use the high-fidelity gramophone and the Western Electric recording K S 6091, popularly known as the fading-numbers record The patient replies not by writing but by speaking the numbers he thinks he hears

By use of this record the child hears words with which he is thoroughly familiar This record played on an ordinary gramophone cannot be used to test patients who have more than 30 db loss of hearing As many of our patients are more deaf than this, amplification must be used Our high-fidelity machine enables us to use this record to test patients with a loss of as much as 84 db It has excellent attenuators, but we believe that the use of these in measuring hearing is inferior to the use of attenuation done in the recording

We are convinced that a more useful estimation of hearing can be obtained by testing a young child with speech than by testing him with pure-tones. We are satisfied that numbers are superior to common words and sentences. Nonsense sentences and meaningless speech sounds we have altogether discarded

Things We Do Not Perform in Testing Children's Hearing

We do not use any test which cannot be performed in a very few minutes and be repeated exactly many times on different occasions, any test which does not command the child's interest frightens it, does not arouse its cooperation, or fatigues it We have no use for watch tests, whisper tests, tuning fork tests or the monochord

We do not use speech audiometry to check the validity and reliability of other hearing tests Speech reception thresholds and discrimination scores have no value whatever in the testing of children's hearing Diplacusis measurements, tinnitus matching, recruitment evaluation, loudness balance, pure-tone averages and practically every other test to be found on audiological work-up charts are useless in the testing of children

Older, very intelligent children sometimes require modification of our regular testing technique, as also do young mental defectives The amount of masking varies These modifications are not stereotyped but are made on the spot by the otologist The latter is qualified to do so, whereas an audiologist would not be

What We Aim for

Our aims are an accurate and authoritative measurement of the child's hearing and a determination of whether his deafness is reversible or irreversible, therefore, we endeavor to use tests which we can repeat exactly, and also to use only those tests which we believe give us practical information

Condemnation of Loud-Speaker Free-Field Testing

Except in special cases, we advise against the use of loud-speaker free-field testing in any hospital clinic devoted to the hard-of-hearing — and especially in such a clinic for children

This advice will cause amazement, because this scheme is the predominant feature of nearly every such establishment set up in recent years

A hospital clinic is not a research unit primarily A hospital clinic exists for the good of the patients and the otolo ists who serve them A hospital clinic requires facilities for iagnosis and for comparative retests

Nearly every technique in use is inaccurate to a degree—ut this technique is much more inaccurate than most — and hould not be used for these purposes

The first important fault is that it makes use of live voice Speech is influenced by the breath stream from the lower espiratory tract, modulated by the vocal cords, varied by the rticulators (lips, jaw, tongue and soft palate) and its overones are selected and suppressed by the vocal cavities (nasal, ral and pharyngeal) The whole process is governed by the rain. It is obvious that these basic speech processes cannot roduce the same sounds for a second testing of the hearing or measured comparison unless they are in the same physical ondition and are used in exactly the same way Even if a ery practiced technician can, with the help of a voice-levelneter, learn how to control the intensity of his voice to an rror as low as 3 db, that does not make it possible for him o make his tests constant in intensity for more than the same day, nor does it prevent him, six months later, from having got out of his bed on the wrong side, or from an intimate sorrow upsetting his laryngeal control, etc. With such things to contend with, his testing procedure, six months hence, may not be the same as it is today

That this contention is valid can be demonstrated visibly to anyone who visits the Western Electric research unit

There can be seen in operation a large speech translator which throws speech on a moving phosphorescent plastic screen so perfectly that observers can read it. The speaker uses a voice-level meter to help him maintain as even an intensity of speech as he can

The visible speech patterns vary not only with the intensity but also with the pitch and with the timbre.

The effect of these on the visible patterns of speech can be quickly discerned by a study of the illustrations in "Visible Speech"[5] There, too, can be seen the variation in the visualization of the same sentences and the same words It will be apparent that the sound pattern of speech continually changes

The next disturbing fact is that all words spoken naturally and in sequence do not have the same physical power In addition, even when carefully monitored to the same effort of speech, all words are not equally intelligible

There are other difficulties in loud-speaker free-field testing The acoustic properties of the soundproof room in which the loud-speaker is used are amazingly difficult to keep constant for subsequent testing everything in the room must be exactly the same as was used at the previous test and in exactly the same position,—the patient must wear the same clothes, if not, the Western Electric Company has proven that the tests are not comparable

The obvious conclusion is that live-voice testing for *measurement* is a delusion

When one contemplates the many thousands of dollars which have been expended in such units and in paying the salaries of the required personnel, one wishes for the tongue and pen of a Jonathan Swift

Necessity for Recorded Testing Material

The consequence of this, namely, that live-voice must not be used, is that the testing material should be recorded The present materials are phonograph record and sound tape

Both phonograph records and sound tape are subject to wear and tear They cannot be expected to retain their fidelity over an extended period of time, but the "master" can be expected to keep its accuracy for years and from it fresh records can be stamped *ad infinitum*

Many recordings are at present available on various materials Your clinic, your hospital, your office is under the necessity of choosing one of these and laying in such a stock of them that your patients for many years to come may be tested by the same testing material under identical conditions

All of the recordings I have studied have defects, but I am sure there are many I have not seen or read about. I am confident, however, that the clinical testing of the future will not be done by live-voice but by recorded speech This may be phonograph record or tape record The ultimate standard of either of these may not be established for some years to come. The point, however, is that the testing material will be a recording of some sort, so that it may be reproduced many times accurately The tests done by such a method will be practical and the results will be comparable

At present, in spite of its defects, I use in my clinic, Western Electric recording K.S 6091 * This is popularly known as the fading-numbers recording (I find the later record, Western Electric K.S 10087, less desirable)

It is the opinion of Hallowell Davis[7] (p 140) that the use of the list of numbers in the Western Electric fading-numbers recording, properly administered, is a measure of the hearing loss for speech of the same precision and reliability as the pure-tone test of a clinical audiometer

Criticisms of Our Scheme

Having criticized other methods of testing hearing, it is proper to note the imperfections of the schemes I advocate.

The faults of the tape recorder are as yet unknown and will not be properly known until it has been in use by otologists as long as gramophone records have been used

The audiologist criticizes the fading-numbers test thus. The recording can be obtained only on the old hard type of recording surface, which produces objectionable noises both available recordings have certain imperfections which considerably annoy the tester, the relatively few combinations of the digits make the use of the fading-numbers record most

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The attenuation in the Western Electric K.S. 6091 is in decibel notation.

difficult to use in rehabilitative work because the short test lists can be memorized, it gives little or no information about discrimination

The answer to these objections originates in the totally different viewpoints of the audiologist and the otologist The latter is a physician, the former is not The latter is interested primarily in his patient's *satisfaction and* well-being, the former is academic and interested primarily not in clinical research but in scientific research

The surface noises, providing they are minimal, the loss of fidelity from wear, providing replacements are readily obtainable, the imperfections in the recordings, the memorizability of the lists, and the testing of discrimination are venial faults They are all capable of improvement by alteration They are as nothing compared with the value the records possess of being useful for comparative retesting

It matters nothing to the audiologist whether a patient's hearing for speech improves, remains stationary or becomes worse, but to the patient and to the otologist these mean everything

In some states, in the screening of the school population the fading-numbers test is being replaced by a pure-tone audiometer test because of certain supposed imperfections of the fading-numbers test These are loss of validity because the children, thinking it is some sort of school examination, are very apt to cheat or try to copy from each other, the method fails to detect early high tone deafness, the diagnostic curves show a lesser degree of accuracy than those of other testing methods, the operation of the test usually disrupts the entire class and too many repeats and referrals are required

The advantages of the pure-tone audiometer for screening (which I personally doubt) are said by the protagonists to be greater ease of operation, it is possible to command individual attention without interference from other children, the diagnostic curve shows greater degree of accuracy, it enables a trained technician to examine an entire class with much greater speed than is possible with other methods and 20 to 30 children can be tested in both ears within an hour by sweep testing

It matters not to us as otologists which of these methods seems to prove most practical for screening in schools Our interest is entirely that children with incipient hearing impairment should be discovered so that appropriate steps may be taken early for their improvement. I will be glad to see the old screening method disappear from the public schools because the faults found with the fading-numbers test in school screening have been responsible for the lack of recognition of its very real merits.

The otologist is keenly interested in every test which brings him information which he can use for his patients' improvement. The great mass of the tests now used in audiology are of no use to him His crying need at present is for a method which will provide data which can be compared with re-examination data of patients as they return As I have inferred above, I believe that he can obtain this by using Western Electric K.S 6091 in a high fidelity reproducing unit

The Hearing Aid Problem.

A hospital hearing clinic may be asked to choose, to recommend and to evaluate hearing aids, however, it is debatable whether any hospital should undertake this Because of its commercial significance such work is surrounded by pitfalls which will not be enumerated here In my opinion a great hospital, and much more a great university, should have nothing to do with it

Every large city should endeavor to obtain unbiased hearing aid service for the ever increasing multitude of hearing-aid wearers In New York City such work is performed admirably by the New York League for the Hard-of-Hearing, a partially voluntary organization In Great Britain such service is obtainable in innumerable cities and towns.

There are many hard-of-hearing children who are benefited by hearing-aids, and undoubtedly there are many more who could be Every large city should provide classes designed to prepare children to wear hearing-aids Until voluntary organizations or boards of education provide these, a children's hospital may be required to make provision to do this It is, however, service which requires much space and special teachers, and it is debatable whether a hospital is the proper place for such work

Need for a Teacher of the Deaf

It is, however, certain that a hospital for sick children should employ an experienced teacher of deaf children

It is commonplace that very few mature adults attain proficiency in lipreading, but those who work with little children know that the child of four or five learns to lipread very easily if he is intelligent

It is the growing recognition of this that has led to the institution of preschool classes for the hard-of-hearing In Toronto we have only one such class Hence to a hospital for sick children will come mothers of children of preschool and younger age, not only from the city but from nearby municipalities and from all over the province We hope to encourage such a mother to stay in Toronto for a long enough period to obtain instruction from our teacher on how to conduct herself with her child at home Many an intelligent mother will learn to teach her little child to lipread with immense benefits to the child

I believe that a well-trained, well-educated teacher of the deaf is indispensable for a hard-of-hearing clinic for children It is all important that the one chosen should understand and love little children She has to demonstrate patiently to the children and to the parents the fundamentals of how remnants of hearing can be utilized in the future education of the child, for it is the very early years of a child's life that are all important The sphere of influence of such a teacher is very great

Regarding Permanency or Irreversibility of Perceptive Lesions

It is service to the little hard-of-hearing child that is the all important object of testing and examining it. The purpose should not be to decide whether or not an operation can be usefully undertaken by a fenestrationist Consequently the location of the underlying lesion in the perceptive apparatus is not of prime importance

As a heritage from the past, otologists make their first diagnostic objective the determination whether the lesion responsible for the deafness is or is not in the perceptive apparatus Because there are obviously irreparable lesions of the internal ear, the assumption is made that every lesion of the perceptive apparatus is irreversible and, therefore, incurable Having made such a diagnosis, any attempt to ameliorate the condition by treatment is considered futile and even dishonest.

We ought to know better There are many lesions of nerves which recover There are lesions of the optic nerve which recover In disseminated sclerosis a degree of recovery may occur spontaneously and persist for many years A large scotoma may diminish in size until it is almost completely gone Multiple sclerosis and pernicious anemia are the two most common examples of demyelinating diseases where recovery can occur providing the axis cylinders have not been damaged to an irreversible degree. Hyland, Watts and Farquharson* in a long study of pernicious anemia patients have reported improved functioning of reversibly affected fibres in the tracts of the spinal cord due to maintenance of adequate therapy

It is, therefore safer to assume that lesions of the perceptive apparatus of the ear are in their early stages at least reversible and amenable to treatment.

Let me give you an example a six month-old patient of ours was a candidate for adoption. There was no evidence of any hearing and no ocular response to douching with cold water We advised against adoption, and as our findings remained unchanged we continued to do so At 18 months, because its attempts at babbling were not flat and toneless, we said there was still hope At the age of two years and one month the child commenced to put three and four words together

We are in the infancy of an understanding of the problems of perceptive deafness

We must be very slow in saying that a child who apparently has a serious perceptive lesion cannot recover

As a corollary to the above assumption it is commonly believed that a lesion of the conduction apparatus is usually amenable to treatment It is, however, easy to find in the literature pictures of fully organized deposits in the middle ear which are irreversible and incurable

We should, therefore, stop concentrating on lesions of the internal ear and instead we should devote our attention to finding variations in the patient's hearing Variation can occur with both conductive and perceptive lesions If the hearing really varies, the underlying lesion is not yet permanently fixed and should be amenable to treatment At present there is no test which demonstrates variability as effectively as the speech test

Attention to Treatment Essential

Children have immense powers of recovery and the otologist who finds variation in a child's hearing should be medically minded and not surgically minded

The number of patients whose hearing is defective because of a congenital lesion is small The vast majority are hard-of-hearing because of disease, usually infection It is of fundamental importance that the otologist recognize the earliest signs of the disease and arrest the process at that stage if he can He must watch the progress of the patient by measuring the hearing of the young child, a procedure which this paper has shown to be very difficult

One otologist, whom I admire, has written that the testing of the hard-of-hearing children and their future handling should be the audiologist's task. It is my opinion that the audiologist will never be fitted to do such a task

Visit any clinic you will, and you will be impressed by two things the time devoted to audiologic technique and work up is very great, much attention is given to the education of the parents by the audiologist, but the time devoted to history taking, examination, and treatment of the child is brief

This is not as it should be The most important part of all and the part that *should* be great is the estimation of the child's hearing ability by the otologist and his continued attention to the problem

The measurement of the hearing in the very young child is extremely difficult and requires suitable techniques, but it is of fundamental importance because it is the indispensable index to the results of treatment.

Deficiency in hearing is caused in a small percentage of the population by defects present at birth. In the vast majority of instances, however it is caused by disease, which itself has a beginning

The defect in the hearing of an adult in many instances has been present so long that it is irreversible. The adult's defect should have been arrested at its beginning in childhood

The treatment of suppurating ears in children should not be passed over to a nurse or young doctor, for the younger the child the harder the problem of treatment It requires the care and perseverance that only an older otologist who is impressed with the responsibility of his task can give

It is the ambition of this clinic of the Hospital for Sick Children of Toronto so to arouse the medical profession that early attacks upon the hearing apparatus of the young child will be arrested and the changes that have been produced will be wiped out while they are still reversible

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BILATERAL MIDLINE PARALYSIS OF THE LARYNX OF CENTRAL ORIGIN

ITS OCCURRENCE AS A POSTOPERATIVE COMPLICATION *

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Bilateral midline paralysis of the larynx following surgery on a part of the body other than the thyroid is alarming because it is unexpected It is serious because of the pulmonary complications which follow

The author first observed a patient with such a paralysis in 1946 The patient following section of the trigeminal nerve for tic douloureux, developed dyspnea, stridor and occasional cyanosis on the afternoon of surgery Direct examination of the larynx revealed the vocal cords immobile in the midline. A search of the literature at that time showed the only reference to such a postoperative complication to be made by Jackson.[1] He stated that bilateral incomplete paralysis of the larynx had been observed as a transitory condition after operations in regions remote from the thyroid—in two instances following abdominal surgery It was assumed that the paralysis was caused by intracranial disturbances, probably circulatory

Interest in the condition has been reawakened by our encountering three additional cases during the past two years

Etiology — The sudden appearance of the paralysis and the bilateral involvement led to the conclusion that the causative lesion is a vascular one located in the medulla The possible lesions are spasm, hemorrhage thrombosis and embolism

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From the Department of Otolaryngology Veterans Administration Center

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Behrend and Riggs[2] state that cerebral complications following surgical operations are not rare, and found such complications were seldom the result of embolism or hemorrhage

New and Childrey,[3] in a study of 217 cases of paralysis of the vocal cords, found 24 which were central in origin Four were due to hematomyelia and one to thrombosis of the medulla Three of the 24 cases were bilateral abductor paralysis

Work[4] described a patient who presented clinical indications of multiple, small cerebral thrombi Bilateral abductor paresis of the vocal cord was noted Examined at a later date, the patient showed complete recovery

Cody[5] examined a patient with sudden onset of paralysis of half the soft palate, half the tongue and abductor paralysis of one vocal cord Re-examination seven hours later showed that all the structures were no longer paralyzed He attributed the transient paralyses to vasospasm in the medulla He enumerates thrombosis of the arteries supplying the medulla and vasoconstriction of the radicular arteries to the motor nuclei as vascular conditions causing the laryngeal syndrome of the medulla

King and Gregg[6] list cerebral hemorrhage as a cause of laryngeal paralysis

Location of the Lesion — Bilateral midline paralysis of the vocal cords is produced by involvement of the abductor fibres in the inferior laryngeal nerve of both sides Corticobulbar fibres carrying impulses to the lower motor neurons, which supply the larynx, arise in the precentral gyrus of the cerebral cortex They pass downward through the internal capsule to the medulla, where they undergo partial decussation and terminate in the nucleus ambiguus around cells of the recurrent and superior laryngeal nerves, thus, impulses brought to the cells of origin of the recurrent nerve on one side arise from the cerebral cortex of both sides

Furstenberg[7] points out that a lesion above the nucleus ambiguus will produce laryngeal paralysis only if large enough to affect the corticobulbar fibres on both sides The paralysis would then be bilateral and spastic

Jackson[1] points out that at, or near, the partial decussation of the motor fibres, a small lesion can reach the upper motor neurons of both sides and thus produce a bilateral motor paralysis of the larynx. Such a lesion, being above the nuclei ambigui, would be spastic in nature Work[4] believes that spastic paralyses of supranuclear origin are often missed, especially if transient and incomplete Furstenberg[7] believes that unilateral lesions are overlooked because of the slight impairment of laryngeal function, but that bilateral paralysis causes such a profound disturbance that a laryngologist is promptly consulted

In the medulla, the nuclei ambigui are not far apart and the same is true of the recurrent laryngeal nerves, hence a lesion here may cause a bilateral laryngeal paralysis Such a lesion produces a flaccid paralysis

Cody[5] points out that the radicular arteries supplying the nuclei ambigui are long and slender and more exposed to vascular disorders. They are more frequently affected than other vessels of the medulla

Woodward[8] points out the close association of the nuclei of the glossopharyngeal, spinal accessory and hypoglossal with the vagus nucleus in the medulla and the resulting frequent association of paralyses of these nerves when the vagus is involved

Cody[5] and Furstenberg[7] also stress the fact that central lesions causing laryngeal paralysis frequently involve the IXth XIth and XIIth nerves in addition.

King[6] states that he has seen no laryngeal paralysis resulting from a central lesion that was not associated with paralytic disturbances of the muscles of the pharynx and tongue, and frequently with motor disturbances remote from the larynx however it must be remembered that vascular lesions sometimes cause transitory paralyses and the finding of associated paralyses will depend upon the relationship of the time of examination to the time of onset of the lesion

Pathology and Pathologic Physiology—Behrend and Riggs[3] studied the protocol material from 21 patients who had cerebral complications following surgical operation Five of these patients had shown symptoms of focal paralysis In every case the brain showed generalized capillary damage with widespread parenchymatous degeneration due to pericellular and interstitial edema In eight patients, who had survived the operation from two to nine days, there were focal areas of glial and phagocytic activity suggesting beginning repair and scar formation Edema and congestion of the viscera were also observed The anesthetic had been ether in 12 cases, cyclopropane in four, nitrous oxide in three, and procaine hydrochloride for spinal anesthesia in two

These authors felt that the cerebral complications following surgical operation were due to cerebral anoxia resulting from acute circulatory collapse, precipitated by the administration of an anesthetic in persons with reduced circulatory reserve

Wilson, Rupp, Riggs and Wilson[9] studied 542 cases of cerebral vascular accident Their findings suggested that systemic circulatory inadequacy played an important rôle in the causation of cerebral vascular accidents

Hicks and Warren[10] state that the cause of virtually all cerebral vascular accidents (excluding aneurysm) is local ischemia This is true whether the lesion is hemorrhagic or nonhemorrhagic and whether or not thrombosis is present In a study of 100 cases of fatal cerebral infarction, a majority of cases showed no evidence of mechanical occlusion of cerebral vessels They conclude that vasospasm is the most common cause of the ischemia

Sherman and Grinker[11] stress the relationship of cerebrovascular accidents to diseases of the cardiovascular system They point out that, although there is a free capillary anastomosis within the brain, it is insufficient to maintain an adequate circulation in an area of any one artery which is occluded Although the evidence is not entirely convincing that cerebral vasospasm of sufficient intensity to occlude an artery can occur, they feel that, from a clinical standpoint, many cases of transient neurologic dysfunction are explicable only on such a basis

Occlusion of a cerebral vessel for as long as two minutes results in a parenchymatous reaction with interstitial edema hyperemia of neighboring vessels and reversible damage to brain tissue. The clinical signs of such a lesion may disappear within several hours or several days Longer periods of occlusion produce irreversible damage.

Pickering[12] credits Peabody, in 1891, with being the first to ascribe transient attacks of paralysis to spasm of a cerebral artery According to this theory, a cerebral arterial wall contracts, obliterating the lumen, the corresponding area of brain becomes ischemic and a corresponding localized sensory or motor paralysis ensues Pickering feels the evidence for vasospasm of cerebral arteries is slight He concludes that attacks of localized sensory or motor paralysis are due to edema of the brain. The edema is less likely to be due to constriction of the artery than to defective constriction

Houssay[13] states that CO_2 is the most powerful dilator of the cerebral vessels and that ether also acts locally on the cerebral vessels to cause dilatation Nervous disturbances of short duration have been attributed both to vasospasm and vasodilatation

From a review of the foregoing extracts we find that various authors agree that the basic cause of paralysis of central origin is local ischemia secondary to edema, that, if the paralysis is transitory, the local pathological lesion must be a reversible one, that long periods of ischemia cause irreversible damage to brain tissue and the resulting paralysis is of longer duration

There is, however, wide divergence of opinion regarding the basic pathologic physiology Some investigators feel that vasospasm is the primary cause Others attribute ischemia and edema to vasoparalysis and circulatory insufficiency associated with disorders of the cardiovascular system In rare instances it may be due to hemorrhage, thrombosis or embolism

Symptoms — As Jackson[14] points out, bilateral laryngeal paralysis is often overlooked This should be especially true in patients recovering from surgery who are on bed rest and sedation The outstanding symptoms of midline paralysis are inspiratory dyspnea and stridor The symptoms vary in degree and may appear only on exertion Usually the voice changes are slight

Complications — With the obstruction to pulmonary drainage caused by the immobile vocal cords, secretional obstruction soon becomes prominent In addition, if there is accompanying motor or sensory paralysis of the pharynx, the nasopharyngeal and salivary secretions find their way into the tracheobronchial tree to be added to the pulmonary secretions Gray,[15] Von Leden,[16] Galloway[17] and others have called attention to the seriousness of the accumulation of these secretions in the lower bronchial tree

With obstruction to the removal of secretions, reduction in the ventilation capacity occurs This leads to hypoventilation, retention of CO_2 in the body and an increase of CO_2 in the blood Hypoventilation also reduces the O_2 saturation of the arterial blood This disarrangement of the relative O_2 and CO_2 content of the blood soon brings about a change in blood pH A combination of these factors leads to asphyxia

In the early stages of such complications, patients show restlessness, apprehension and disorientation This may lead to further sedation and further depression of the respiratory center Two significant early signs are nonproductive cough and the presence of rhonchi in the chest

Usually at this stage the patient is treated by postural drainage, catheter suction and perhaps bronchoscopic aspiration In addition the patient receives O_2 therapy All of these measures fail to relieve the dyspnea and stridor for any significant length of time

If the obstruction continues, edema, atelectasis and pneumonitis appear

Diagnosis — If the laryngologist is consulted, mirror examination shows the cords to be immobile in the midline Therapeutic bronchoscopy for the aspiration of accumulated secretions may also reveal the diagnosis, however, unless the possibility is kept in mind, the endoscopist, in his anxiety to relieve a very sick patient, may overlook the paralysis since the bronchoscope is passed without too much difficulty into the trachea The paralysis viewed through the bronchoscope may be mistaken for a spasm of the glottis

The inspiratory stridor and failure of aspiration of retained secretions to relieve the dyspnea should suggest obstruction in the larynx itself

Differential Diagnosis — The important differential diagnosis in postoperative laryngeal paralysis is to differentiate it from obstruction that is due to simple retention of retained secretions. This is important because, while aspiration of secretions, postural drainage and administration of O_2 may suffice in the treatment of the latter condition, they will prove insufficient if the vocal cords are paralyzed

Abductor paralysis must also be differentiated from post operative edema of the mucosa of the larynx and of the hypopharynx Modlin[18] in discussing a paper by Gius and Grier, reported six patients requiring tracheotomy postoperatively following bilateral neck dissection with removal of both internal jugular veins This procedure was necessitated by alarming postoperative edema of the larynx. It was necessary to maintain the cannula in place for as long as three weeks postoperatively In one of our cases of laryngeal paralysis following bilateral neck dissection the paralysis was not apparent until the edema of the hypopharynx and larynx had begun to subside.

At times the reaction to an intratracheal tube used for anesthesia may confuse the diagnosis This was true in another of our cases which showed moderate ecchymosis and edema of the pharyngeal mucosa in addition to the laryngeal paralysis

During an epidemic of poliomyelitis, particularly following an emergency operation, it would be well to differentiate the bulbar type of polioencephalitis from abductor laryngeal paralysis

Treatment — The immediate treatment of bilateral midline paralysis of the vocal cords is tracheotomy The introduction of a tube into the trachea bypasses the laryngeal obstruction and in cases of associated paralysis of the pharynx, either motor or sensory, it lessens the danger of aspiration of secretions If the complication of secretional obstruction has already supervened, this condition is more readily treated by repeated aspiration through the tracheotomy cannula

The importance of treating the primary condition is emphasized by the findings of Ende and Ziskind,[10] who in a series of 137 consecutive autopsies found three postoperative deaths due to asphyxia from retained tracheobronchial secretions

Fortunately, the present day tendency is to treat all cases of respiratory difficulty due to retained secretions by tracheotomy if the condition is likely to persist for more than 24 hours This makes for ease of nursing care by personnel with no specialized training Thus, even if the diagnosis of a postoperative laryngeal paralysis is missed or delayed, the proper treatment would possibly be instituted on an empiric basis

The majority of cases of laryngeal paralyses that we have seen complicating surgery other than thyroidectomy, have resolved in from four to six weeks, however, if the paralysis persists longer than six months, it is likely that gliosis and scar tissue formation have taken place in the central area involved In such a case surgery on the larynx as devised by King, Kelly, Woodman and others may be necessary if the patient is to be decannulated

CASE REPORTS

Case 1 A female patient, past the fifth decade was admitted to a voluntary hospital in Albany, N Y, in January, 1946, because of trigeminal neuralgia Under general intratracheal anesthesia, a section of the Vth nerve was performed intracranially Shortly after recovery from the anesthetic the patient had an attack of cyanosis. The anesthetist was called and he aspirated the tracheal mucosa and administered oxygen. Because the patient had anesthesia of the pharynx it was possible to examine the vocal cords directly This examination revealed a bilateral midline paralysis of the vocal cords. Because the dyspnea persisted with recurrent cyanosis a tracheotomy was performed on the same evening as the original surgery This relieved the patient s symptoms During the next few days the anesthesia of the pharynx disappeared and the mobility of the vocal cords returned within two weeks. The patient was then decannulated the tracheotomy wound closed by a plastic procedure and the patient discharged from the hospital.

Case 2 E. H. aged 66 white female was admitted to the Veterans Hospital for surgery of a recurrent carcinoma of the breast. Original surgery on the breast had been performed in February 1946 and followed in 1948 by irradiation. The patient had a systolic murmur in the mitral area but there was no cardiac enlargement. On Oct. 16 1950 under pentothal and intratracheal nitrous oxide anesthesia the lesion of the chest wall was removed and a skin graft applied On the second postoperative day the patient was examined because of dyspnea and stridor There was ecchymosis of the palate and swelling of the false cords. The true cords were not visualized Chest X ray showed no atelectasis. Two days later because of persistent dyspnea a direct laryngoscopy was performed and it was then found that the patient had a bilateral midline paralysis of the flaccid type. Tracheotomy was performed which relieved the dyspnea. By Nov 15 1950 the cords were moving normally on abduction and the tracheotomy tube was removed

Case 3 C. H aged 63 white male was admitted to the Veterans Hospital on Sept. 20 1951 because of pain in the abdomen of one week s duration. In 1945 the patient had suffered a compound fracture of the skull with damage to brain tissue. This left him with a left hemiparesis Chest X ray on admission revealed moderate cardiac enlargement. Abdominal examination revealed an incarcerated mass in the right inguinal region. His blood pressure was 128/70 An emergency inguinal herniorrhaphy and appendectomy were performed on the day of admission under spinal anesthesia. Late on the day of surgery a bronchoscopy was performed because of signs of retained secretions Two days postoperatively a chest X ray showed pneumonitis at the left base On the fourth day laparotomy was performed because of ileus Bronchoscopy was repeated at this time Chest X ray then showed atelectasis In spite of the administration of oxygen, the patient was dyspneic and cyanotic and moist rales were present throughout the chest. The patient was confused and disoriented and for this reason was receiving sedation. He had also been receiving antibiotics with no appreciable effect upon the chest condition He was coughing but failing to raise any secretion On Sept. 28 1951 he was seen in consultation by the laryngologist. Examination revealed weakness of the tongue and palate and a bilateral midline paralysis of the vocal cords. Tracheotomy was performed and a large amount of thick mucopus aspirated from the tracheobronchial tree The patient s condition improved remarkably within 24 hours both physically and mentally Five days later the patient was able to swallow nourishment. Within three weeks the paralysis of the vocal cords had disappeared. The tracheotomy tube was removed and on Oct. 17 1951 the wound was closed by a plastic procedure The patient was discharged to the domiciliary section on Jan. 7 1952

Case 4 R. W., aged 68 white male was admitted to Veterans Hospital on Aug. 6 1951 because of a mass in the right cervical region. This mass had been present for seven months Ear, nose and throat examination revealed an ulceration at the base of the tongue on the right extending past the midline Another cervical node was noted low in the left cervical region His blood pressure was 156/78 Physical examination and laboratory examinations revealed no other abnormalities Biopsy of the tongue ulcer showed squamous carcinoma, Grade II Deep X ray therapy showed that the ulcer responded to irradiation On Sept 13, 1951, seven radon seeds of 2 5 millicuries each were inserted in the tongue and on the following day, under intratracheal anesthesia, a right radical neck dissection was performed There was moderate postoperative edema of the pharynx and right aryepiglottic fold however, this edema and the irradiation reaction of the tongue gradually subsided The incision healed slowly because of the irradiation On Nov 13 1951 under intratracheal anesthesia with nitrous oxide and ether, a left radical neck dissection was performed When the intratracheal tube was removed at the conclusion of the operation, the patient became cyanotic It was impossible to reintroduce the tube because of the pharyngeal and laryngeal edema A tracheotomy was performed This relieved the cyanosis Postoperatively, there was marked edema of the conjunctiva, pharynx, larynx and cervical region This gradually subsided Mirror examination of the larynx was made on Dec 7 1951 because of inspirational stridor and because patient had dyspnea when the tracheotomy tube was occluded This revealed a bilateral midline paralysis of the vocal cords Occasionally during the next two months the cords seemed to regain slight mobility however five months postoperatively, with all edema of the face conjunctiva and larynx subsided, the cords lie immobile in the midline and the patient can go only a short time with the tube occluded He also has much difficulty in raising mucus unless the tracheotomy tube is open Surgery for bilateral abductor paralysis of the vocal cords is now being contemplated

DISCUSSION

In Case 1 an associated paralysis of the glossopharyngeal nerve was noted when the patient was examined shortly after the onset of symptoms In Case 3 a paralysis of the hypoglossal nerve was also present No associated paralysis was noted in the other two cases, although such a condition may have existed temporarily

Case 2 illustrates well the pulmonary sequelae of obstruction with retention of tracheobronchial secretions It also shows the mental results of anoxia even when O_2 is being administered when the bronchial secretions are not being evacuated

In Case 4 it was difficult to convince the general surgeon that the obstruction was not due to local edema of the larynx and pharynx, however, the persistence of the bilateral paralysis after all edema had subsided seems convincing proof that the paralysis was central in origin

SUMMARY

Four cases of bilateral midline paralysis of the larynx occurring as postoperative complications due to central vascular lesions are presented Two cases showed associated paralyses In three cass the paralysis was temporary In the fourth case it has persisted over five months and appears to be permanent.

The pathophysiological possibilities are discussed

Tracheotomy for the treatment of the paralysis and its pulmonary complications is emphasized

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PERCEPTIVE DEAFNESS IN CHILDHOOD *

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There appears to be very wide variation in the available figures on the incidence of deafness in children Very roughly one may say that one in every 300 boys and one in every 400 girls are sufficiently deaf to require special schooling, and that of these the acquired, postnatal types have been approximately twice as common as the congenital Since both varieties are frequently the result of epidemic disease, statistics must vary considerably from time to time, and from place to place, also, due to constantly improving public health services and epidemic control, acquired forms of deafness should, in time, be very largely eliminated Due to lack of precise knowledge, classifications of nerve deafness have mostly been unsatisfactory The table used in this presentation is similar in most respects to that recently suggested by Victor Goodhill

1 *HEREDITARY* (GENETIC)

A Developmental Anomalies

Aplastic
Degenerative

B Erythroblastosis Fetalis (Kernicterus)

2 *ACQUIRED*

A Prenatal

1 Infections (Rubello — polio — viral)
2 Drugs
3 Developmental (Metabolic — Endocrine — etc.)

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B Natal

1 Birth Injuries
2 Drugs (Quinine)

C Postnasal

1 Local Infections (Labyrinthitis)
2 Systemic Infections (Esp Viral)
3 Drugs (Streptomycin)
4 Trauma (Auditory and Gross)
5 Miscellaneous

1 *Hereditary Deafness*

A Developmental—

Familial deafness is transmitted according to the Mendelian pattern, involving a single recessive gene Its occurrence in the offspring of a deaf patient of this type depends upon the hereditary makeup of the spouse—thus the influence of consanguinity The presence of this type of deafness among the siblings, even if the subject has normal hearing, suggests that he is a carrier of the recessive gene for deafness

In developmental anomalies, there is either a primary lack of development or there is development up to a point followed by regressive changes It consists essentially of one or more anomalies of the cochlear duct usually associated with abnormalities of the saccule and rarely of the bony cochlea, the utricle or semicircular canals It is also often associated with other developmental anomalies such as feeblemindedness, retinitis pigmentosa, familial osseous fragility, and various bodily malformations

Complete deafness is rare In making the diagnosis, a clearcut history is essential in distinguishing this from other forms of deafness

B Kernicterus—

The second variety of hereditary deafness is of considerable interest at the present time The mechanism is briefly as follows

Persons are said to be Rh positive or Rh negative according to whether their blood contains Rh agglutinogen or not — 85 per cent of people being positive and 15 per cent being negative Rh negative persons are liable to develop antibodies — *i e*, against Rh positive cells — if Rh agglutinogen is introduced into the circulation This may occur in either sex as a result of transfusion, and in an Rh negative woman who is pregnant with an Rh positive fetus — the fetus having inherited the agglutinogen from the father It appears that the agglutinogen of the fetus enters the maternal circulation, thereby stimulating the production of the specific antibodies These in turn on entering the fetal circulation in sufficient concentration produce hemolysis Three degrees of this condition have long been recognized, namely

1. Congenital hydrops fetalis — the infant being either moribund or dead at birth
2. Icterus neonatorum in which there is complete jaundice at or within 24 hours of birth.
3. Congenital anemia of the newborn

Unless a woman has been sensitized by transfusion the firstborn is likely to escape, due to lack of concentration of antibodies in the maternal blood but the second and still more the third, child is likely to be affected

The cerebral cortex and cranial nuclei are the areas chiefly involved Rh incompatibility occurs about once in 200 births

2 Acquired Deafness

A Prenatal —

1 Infections — Some years ago maternal rubella became suspect since when its role as the major single cause of infantile deafness has been steadily unfolding The cochlea develops from the sixth week until about the end of the fourth month The degree of deafness depends largely upon the stage of development of the cochlea at the time of onset of the infection Maternal rubella has been found to be the cause of 20 5 per cent of all forms of infantile deafness, and this figure is likely to increase (Goodhill)

As might be expected from the nature of the condition, deafness from this cause is frequently associated with other defects and malformations, including congenital heart disease, congenital cataract, harelip, club foot, microcephaly, hypospadias, spasticity, etc

It is a curious reversal of form that the other exanthemata, which can play such havoc with the hearing of infants and young children, seem to have little or no effect upon the fetal organism, however, another virus disease which has been found to have an unexpectedly high incidence as a cause of deafness is poliomyelitis — again when it occurs during the first trimester

2 Drugs — It is of interest to note that much experimental work has been done in animals on the effects of drugs on the fetal organs of hearing Investigators have reported that changes in the cochlea can be produced which are indistinguishable from those found in developmental deafness Some of the chemicals mentioned are calcium chloride, pilocarpine, guanidine, arsenic acid These findings would lead one to think that deafness from intrauterine toxic factors of exogenous origin may be more common than is generally suspected

B *Natal* — Birth Injuries — Drugs (Quinine)

C *Postnatal* —

Statistics indicate that this reaches a maximum during the first two years of life, after which there is a steady decline — becoming more rapid with each year achieved, however, from the point of view of therapy, there is nothing to choose between a young child who has been born deaf and one who has acquired his deafness within a year or two of birth Neither one can hear, and because of this essential lack, they are both quite incapable of speech without having special training

Infections — Inflammatory states in which the cochlea is invaded form a major cause of this type of deafness, and are generally the result of meningitis, the epidemic form being the greatest offender The mechanism is that of direct spread of infection from the meninges to the cochlea and vestibule by way of the VIIIth nerve and the cochlear aqueduct The contents of the bony labyrinth become replaced to a greater or less extent by the products of infection, which, with survival of the individual, become organized, and form granulations, and these in turn may complete the metaplastic cycle to become bone

Meningitis alone appears to be the cause of approximately half as many cases of deafness as maternal rubella It is closely followed by the virus infections — the exanthemata, however, it must be borne in mind that the majority of infections, both regional and systemic, are capable under suitable circumstances of causing deafness This usually affects the cochlea and only occasionally the VIIIth nerve, for, since the cochlea is phylogenetically the most recently developed organ of special sense, it is correspondingly the least well able to resist or to recover from any form of injury

Drugs — Many drugs have been implicated One of recent import is streptomycin. Deafness from this cause is likely to be both permanent and severe. Recent investigations have shown that at least in some instances the lesion in streptomycin deafness is liquefactive necrosis in the ventral cochlear nuclei The effect of streptomycin appears to differ from that of dihydrostreptomycin

Trauma — Another small group, but one which is acquiring greater significance in this modern age, is that of deafness due to trauma. Briefly one can say that if the labyrinth is involved in the line of fracture, the resulting deafness will probably be complete, presuming that the patient recovers

If the temporal bone is involved, but the labyrinth is not directly implicated, the degree and permanence of the ensuing deafness depends upon the amount of blood which invades the labyrinth and upon its subsequent absorption or organization

Much the same picture may follow concussion without fracture, and at times from a seemingly trivial injury

Age plays a definite part in this category in that the older the patient, the less hearing does he recover from his point of maximum deafness

Diagnosis As regards the *recognition* of deafness in children, it is interesting to note that it is more often the inability to speak than the inability to hear which is first recognized and for which cure is sought So much is speech a function of hearing that without proper training, every child who loses his hearing prior to the age of four years will most certainly become a deafmute, and this is likely to occur with loss of hearing up to the age of eight or even 10 years Another important sequel to the loss of hearing is that the older the child on suffering this loss, and the longer he remains without training, the more likely are personality problems to develop to the detriment of his rehabilitation The psychology of the deaf is peculiar, it produces an exaggerated sensitivity about their affliction with a tendency to withdraw, to irritability and to suspicion

In the very young the estimation of the degree of deafness is unquestionably difficult, but, as already indicated, it is more important to recognize at the earliest opportunity that there is deafness present than to name its type

Tests — Testing is of two varieties

1 The usual type in which the patient voluntarily responds to the test sounds and, —

2 Objective hearing tests in which the examiner is able to observe involuntary responses

The latter is, of course, the kind which has to be employed for infants The most accurate, but somewhat complicated, is probably Bordley's galvanic test in which the patient is conditioned to a faradic stimulus, the response being in the form of a galvanic skin reaction Though less accurate, the much simpler and more frequently used method is to observe various normal, reflex reactions to sound — such as twitching of eyelids, face or limbs

In eliciting these responses in an infant, a great variety of instruments has been used — bells, triangles, drums, etc., the percussion instruments supposedly being most suitable Later, in an effort to gain a better idea of the range of hearing, variously pitched pipes, whistles, etc , are recommended After the age of four or five years the audiometer may be tried, but the young tend to lose interest rapidly Many investigators advocate the early use of the audiometer by means of play conditioning, *e g* , "the peep show," as suggested by Hall pike and associates

Seldom is there a completely dead cochlea If this seems to be the case, the static labyrinth should be investigated Though occurring more frequently in postnatal than prenatal deafness, complete lack of vestibular response is most uncommon.

Differential Diagnosis Since failure of speech development is the most outstanding feature of the severer forms of deafness, any condition which produces or is associated with this failure may cause confusion in the differential diagnosis

The four principal conditions which should be kept in mind in this regard are

1 Mental Retardation — in which there is a backwardness in nonauditory tests, visual inattention, emotional and intellectual lack of response, as opposed to the alertness of the deaf child

2 Speech Delay from Emotional Cause or Lack of Incentive, *i e* , the child of overindulgent parents, or at the other end of the scale, the institutionalized child

3 Motor Speech Delay, which is often seen to coincide with efforts to train away from a preferred left-handedness

4 Developmental Word Deafness — an interference with the receptor mechanism which makes speech unintelligible to the subject and, therefore impossible of reproduction Clinically and therapeutically he is an aphasic.

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REHABILITATION OF THE DEAFENED CHILD *

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One of the most important basic needs of humanity is the ability of communication with one's fellow-men In the normal chain of events, this faculty of communication depends to a great extent upon the two functions, hearing and speech, however in the problem with which we are concerned at the moment, we have learned that it is possible for the added senses of touch, sight and the sense of movement to be utilized in place of, or in addition to, hearing

For a moment, let us briefly review the history of education of the deafened In Roman times the deaf and mute were classed with the mentally incompetent and this condition persisted almost without exception until the middle of the sixteenth century Then Cardano of Padua stated that the deaf could be taught to comprehend written symbols or combinations of symbols by associating them with the object or the picture of the object they were intended to represent, that is, the association of meaningful language with experience Closely following Cardano, Pedro Ponce de Leon of Italy and Bonet of France commenced the oral education of deafened children In 1680, Dalgarno of Italy stressed the fact that deafened individuals were as mentally alert and capable of instruction as a normal person and 'there might be special addresses made to a dumb child even in his cradle" In the eighteenth century, the outstanding figures were Abbé Charles Michel de l Epee in France — who favored signs, and Heiniche in Germany — advocating speech and speech reading The influence of these men was worldwide In 1817, the first permanent public school for the deaf in the United States was

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founded in Connecticut by Gallaudet This was the forerunner of a great system of schools for the deaf, backed by the enthusiasm of Gallaudet's son, Sarah Fuller, Alexander Graham Bell, Caroline Yale and Dr Max Goldstein Thus through the work of these and many others — doctors, physicists, psychologists, sociologists and teachers, we have reached the present status, where all deafened children have the opportunity of education and communication with their fellow-men

Any proper system of education for the deafened child depends upon four main factors

1 Parental education

2 Proper diagnosis and estimation of residual hearing

3 Education by means of auditory training, language training, speech reading, and the use of the hearing aid where indicated

4 An adequate follow-up program

These factors must be considered in detail

PARENTAL EDUCATION

Many parents are loath to admit and accept the fact that their child will never hear They squander much time and money on consultations in one center after another, not realizing the harm they are doing their child by not instituting measures as early as possible Again, other parents accept their child's deafness, and then attempt to "make it up to him" by overdevotion — doing everything for him and shielding him from all contacts with normal living Thus it is that when the child commences his program of education, not only has he been deprived of communication with others, but he is a maladjusted and thoroughly spoiled child as well

The parents should be taken freely into the confidence of the otologist They should be told why the child does not hear, and what can be done to help him, stressing always the important part that they will play in that education If possible, they should be present at least at the first few lessons of the teaching program, in order that they may work in close cooperation with the educator The parents must be shown that education begins at the time the diagnosis is made or even presumed If the child is still a baby, it is held on the lap so that it can see the parent's face and talked to, kindly, lovingly, and in a normal fashion, not with mouthings and grimaces. Then the baby is held against the face and the chest, talking constantly and repetitiously so that it may perceive vibratory stimulation Gradually the child comes to associate the movement of the lips with the vibratory stimulation, and the training of the child has begun, in the mother's arms

The Ewings of Manchester have found that the voice of a deaf child of one year is not noticeable by its abnormalities There is rhythm to the voice and pitch and intensity can be varied, though the variations are fewer than normal however if left alone, about the age of 18 to 24 months, the deaf child tends to lose this range of vocal expression and the voice takes on a strained quality Gestures replace vocalization. Once the deaf child ceases to use his voice, the natural intonation never can be recovered Thus the use of the voice must be constantly encouraged, so that the sounds become automatic and eventually form the natural basis for the development of speech Articulation has to be taught speech as such can never be taught. It must become part of the child's mental and social experience and must be the result of an inner urge All this lies within the realm of parental teaching, but they in turn must be helped greatly

To facilitate the parents' education, various reading material may be recommended! the *Volta Review*, the publication of the American Association to Promote the Teaching of Speech to the Deaf, and the Volta Bureau, the *Hearing News* of the American Hearing Society, they may enroll in the John Tracy Correspondence Course or they may contact their Provincial School for the Deaf for further educational material In this way, the parents gain more insight into their child's problem.

PROPER DIAGNOSIS AND ESTIMATION OF RESIDUAL HEARING

The matter of diagnosis has been covered very adequately in a preceding paper It has been shown that practically all of the congenitally deaf cases have some island of residual hearing which can be utilized for educational purposes Likewise, many of the cases of acquired deafness have some degree of hearing reserve In a series of 460 cases investigated at the Pennsylvania School for the Deaf, residual hearing to one frequency was found to be present in 95 per cent of cases, but only 25 per cent could hear frequencies above 512 d v , however, any degree of residual hearing can be utilized in speech reading, where the child gathers his speech impressions from all his senses at the same time — visual, kinesthetic or muscular cues, and auditory

The initial stage in the estimation of residual hearing is to gain the interest of the child In most cases, there has been no preliminary parental education and the child is presented as a fretful, restless and ill-tempered being, with willfulness and self-determination the predominant emotions No attention is paid to sound, and until the child is taught to listen, little progress can be made To initiate this desire, training in a conditioned response is begun The simplest conditioned response is that of raising the hand when a loud sound is presented at the ear As a preliminary stage, this sound should stimulate both the auditory and tactile senses, such as a buzzer operating a telephone receiver Thus, even if no hearing is present, with proper training a conditioned response to a tactile stimulus is set up, but as we have shown, 95 per cent of deafened children have some residual hearing, so we proceed from there It is to be noted that throughout the training period, the child's behavior improves remarkably He becomes attentive and obedient and easier to handle in all ways When it is decided that the responses to the training device can be relied upon, a reasonably accurate audiogram may be obtained We are then ready to proceed to the actual education of the child

EDUCATION

The education of a deafened child should proceed along the lines of auditory training, speech training and language, and speech reading

First, auditory training As has been intimated previously, if there is even a suspicion that a child is deafened, his early years should be filled with loud and varied sounds Thus, he is taught awareness of sound which provides another link to the world about him This awareness of sound leads to the next step of discrimination of sound, *i e*, the ability to differentiate one sound from another For this purpose, the teacher may use a drum, a bell, a rattler, a whistle (preferably of low pitch) and a bicycle horn The child is shown the objects and the noise they make. He is allowed to play with them and sound them himself Then the sound is made out of sight of the child and he is required to pick out the instrument from which the sound emanated From this stage finer discriminations may be made, for example, bells of different pitch Once a child learns that sounds differ from one another, he is ready to start learning to understand speech Here again one begins with the gross discriminations between vowels — "ah' and "ee" — quite dissimilar Then one works slowly on to the consonants Following thus, the child is taught to respond correctly to short sentences — 'Bring me your coat," 'Where is your hat?", etc In this way the child assigns meaning to the phrase without analyzing each part. It closely follows the normal pattern of learning As training progresses, finer discriminations are taught — the difference between "S" and 'SH," between "TH" and 'F ' He must know and understand a large vocabulary of words, and must be able to follow connected speech from conversation periods, stories phonograph records, etc.

A very important adjunct to auditory training is the hearing aid, however, before a child is fitted with a hearing aid, his auditory training must have progressed through the stage of awareness of sound and discrimination of sound to a degree that he will receive some practical benefit from the instrument Every acoustically handicapped child who can benefit from a hearing aid should be fitted with his own instrument as soon as he is ready for it At first, the teacher covers her lips to forcibly submerge lipreading Later lipreading and hearing are trained simultaneously Only with the hearing of speech can the proper imitation of speech be possible, and the flat, unintelligible speech of the deaf be avoided

In this connection there has been an instrument produced by the Maico Co , called the Train-Ear, which consists of amplifier, phonograph turntable and radio, which is proving of great value in the re-education of the hard-of-hearing child

The second stage in education consists of speech learning and language Now that the child has become aware of sound, and his residual hearing has been trained to interpret differences in sound, and the voice as a medium of communication, he must be taught to speak properly In the child with a sufficient reserve of hearing in all frequencies, this is a matter of continuing the foregoing training, with emphasis on the hearing aid, and speech reading, however, in those cases in which there is residual hearing only for low frequencies or no residual hearing whatsoever, it becomes a more painstaking procedure, and additional methods must be utilized In the development of language, it is necessary to associate an idea with a word Once the recognition of this association is obtained, the development of language has begun To teach the word "jump," the teacher jumps To teach the word "ball," the object is shown, together with the name of the object on a card Thus, gradually, a limited vocabulary is built up

In building up a child's store of language, three major channels are substituted for the ear vision, touch and muscular movements or kinesthetic clues By visual clues, the child learns to interpret gestures and the facial activity that is the visible part of speech He is then started on the road to speech reading Through the sense of touch, the child learns of the plosive consonants (P B, etc) by feeling the gust of breath By the hand on the cheek, the nose or the larynx, he gets further information on certain sounds which give most vibration in these areas By producing the same vibration in himself, he is continually adding to his vocal knowledge. By the kinesthetic cues, the child learns of the jaw movements, tongue movements, etc., necessary for the formation of intelligible speech. Thus, whereas the normal person judges speech on how it sounds, a deaf child must base his speech on how it feels.

The third important part of education consists of speech reading, a more inclusive term than lipreading In the English language, over 50 per cent of all speech elements are either invisible or indistinguishable In the normal flow of language the invidual speech elements have a duration of only one-thirteenth of a second, therefore, visual perception of the spoken language cannot depend upon the recognition of the individual letters, but must also take into consideration muscular movements, as well as context and other clues The deafened child must observe the rhythm of sentences, the timing of syllables and the pauses between, the facial expressions and gestures Thus, he must be continually on the alert, and in many cases, tension and fatigue are produced in a short time, however, it is from this final stage in his education that the child achieves the ability of communication with others

The education of a deafened child is thus shown to be a continuous process from the time the deafness is diagnosed or presumed, through the stage of parental education, nursery school and specialized schools for the deaf until they are judged able to continue their studies with normally hearing children in public school The earlier training is begun the sooner can this objective be obtained It has been found that with preschool training 90 per cent of partially deafened children and 50 per cent of profoundly deafened children can carry on at public school, however without this preschool training, only 49 pei cent of partially deaf and 1 per cent of profoundly deaf children were able to carry on public school instructions

The responsibility does not end here There must be a comprehensive follow-up program The hard of hearing child, who relies upon a hearing aid, must be rechecked regularly, and, if his hearing is deteriorating, appropriate lines of training must be instituted Some children may fall into slovenly habits of speech or their speech reading may deteriorate, necessitating a brief brush-up course, but, throughout it all, slow and painstaking as it may seem, is the constant inspiring thought that a child has been salvaged to lead a normal life and take his place in society

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ODONTOGENIC TUMORS AND CYSTS *†

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Odontogenic tumors and cysts are frequently encountered in the practice of otorhinolaryngology Such encounters are often fraught with confusion, for several reasons

The terminology used in discussing these structures is usually more familiar to the dentist than to the doctor of medicine The nosology, i e , the classification, of these conditions is difficult. Some would include various developmental malformations, such as the fissural cysts[1] This paper includes only those conditions purely odontogenic (Gr odous or odont, tooth plus genneo, I produce or generate) Finally, as emphasized by Willis,[2] the understanding of these conditions is based upon an understanding of the embryology concerned

GENERAL STRUCTURE OF A TOOTH

These fundamentals, the terminology, nosology and embryology, must next be considered, first starting with the general structure of a tooth (see Fig 1) As indicated, there is a crown and root portion, with enamel, dentine, cementum and pulp constituents. The embryological development of these components must next be considered, since it is their maldevelopment which accounts for the odontogenic tumors and cysts

EMBRYOLOGY

Starting about the fifth or sixth week of embryonic life, there occurs a thickening of the oral stratified squamous

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mucosa at various points along the alveolar process (see Fig 2) Observing one of these thickened areas diagrammatically, and following it along, the proliferation is seen to continue

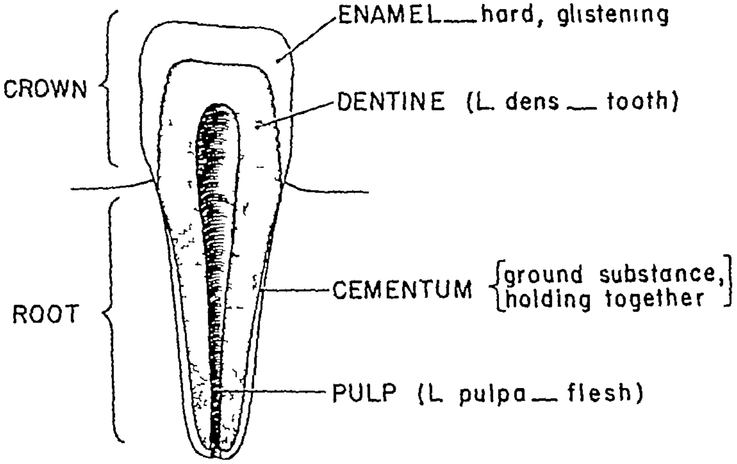
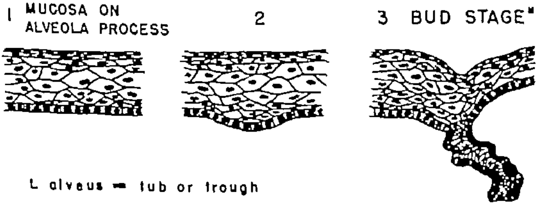


Fig 1

until there is a downward extension of the epithelium into the submucosa The appearance of this downward projection characterizes the so-called "bud stage" (see Fig 2)

As this bud extends deeper, a knob-like thickening occurs at its deepest portion (see Fig 3) (A second thickened area at the middle of this bud will eventually form a permanent tooth) This knob-like end then begins to flatten out, so that the entire structure looks somewhat like a mushroom The stem of the mushroom, the cord of epithelium which extends from the oral surface into the submucosa, is called the dental lamina The cap of the mushroom, for which reason this is designated the "cap" stage, consists of this flattened epithelial structure which now develops a central area of different consistency This area is filled with a loose, stellate reticulum Toward the oral mucosa the stellate reticulum is bordered by what is now designated the outer enamel epithelium, its other, deeper surface is bordered by the inner enamel epithelium These three collectively are designated the enamel organ


1 MUCOSA ON ALVEOLA PROCESS
2
3 BUD STAGE*
ORAL EPITHELIUM PROJECTING DOWNWARD

L alveus = tub or trough (tooth socket)

PROCESS = the projecting bony ridge containing these sockets

GINGIVA (L gum) = Connective tissue covered by mucosa

Fig 2.

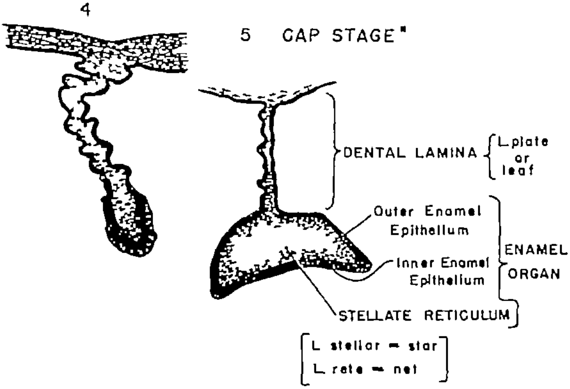


Fig 3.

There now follows a condensation of mesenchymal tissue about this enamel organ (see Fig 4) This occurs especially under the inner enamel epithelium, and gradually pushes upward, forming a nipple-like projection, called the dental papilla As a result, the former "cap" now looks more like a bell, and this is, therefore, called the "bell" stage

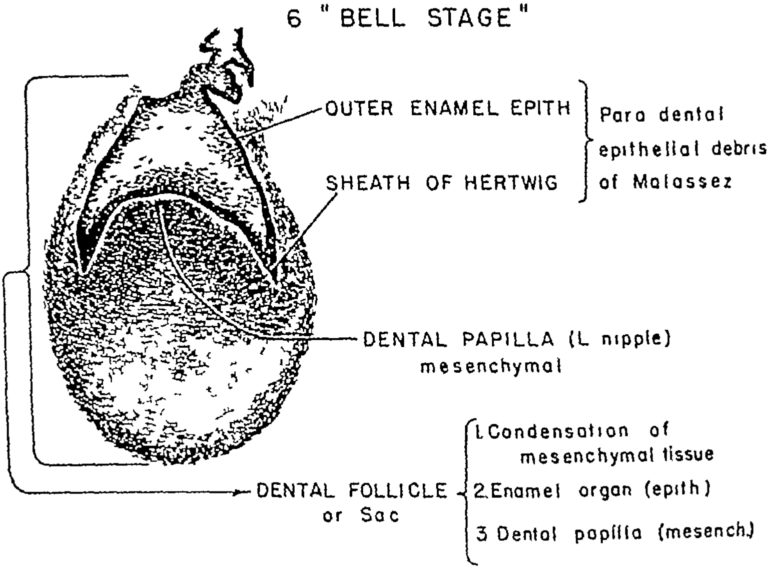

6 " BELL STAGE "
OUTER ENAMEL EPITH
SHEATH OF HERTWIG
Para dental epithelial debris of Malassez
DENTAL PAPILLA (L nipple) mesenchymal
DENTAL FOLLICLE or Sac
1. Condensation of mesenchymal tissue
2. Enamel organ (epith)
3 Dental papilla (mesench.)

Fig 4

The juncture of outer and inner enamel epithelium forms a progressively more sharp edge In three dimensions it can be visualized as the free edge of the "bell" This is the sheath of Hertwig It and the outer enamel epithelium normally atrophy They are collectively called the Paradental Epithelial Debris of Malassez

With atrophy of the dental lamina and also with the formation of the epithelial debris, three structures are left isolated These are the condensation of mesenchymal tissue, the enamel organ, and the dental papilla They make up the primitive dental follicle or sac

The inner enamel epithelium now develops the ability to form enamel (see Fig 5) Its cells are, therefore, called ameloblasts (amelo, enamel) or adamantoblasts Opposing them, a layer of mesenchymal cells develop the ability to lay down dentine. They are, therefore, called odontoblasts The formation of odontoblasts and the deposition of dentine are dependent upon the presence of an enamel organ

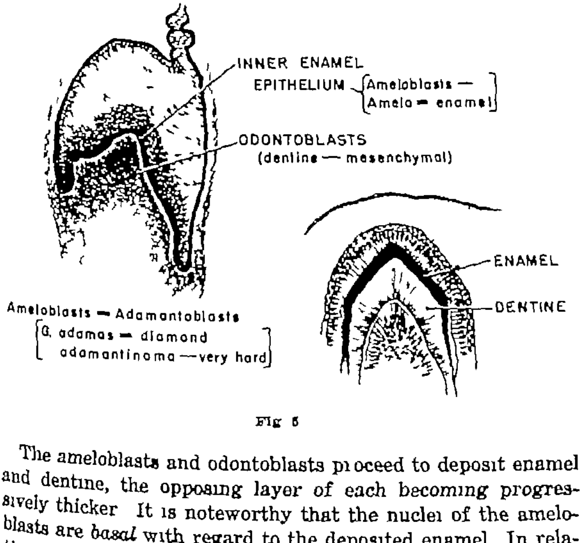

INNER ENAMEL EPITHELIUM
Ameloblasts — Amelo = enamel
ODONTOBLASTS (dentine — mesenchymal)
Ameloblasts = Adamantoblasts
G. adamas = diamond
adamantinoma — very hard
ENAMEL
DENTINE

Fig 6

The ameloblasts and odontoblasts proceed to deposit enamel and dentine, the opposing layer of each becoming progressively thicker It is noteworthy that the nuclei of the ameloblasts are *basal* with regard to the deposited enamel In relation to the stellate reticulum, the nuclei are *non*basal, an important point in discussing adamantinomas later

Mesenchymal connective tissue meanwhile invades the sheath of Hertwig, pushing it outward to become debris With further condensation the connective tissue becomes the cementum (see Fig 6), and there is now a crude representation of a tooth.

It can be visualized that with further differentiation, further projection of the tooth into the stellate reticulum and separation of the overlying oral tissues, the tooth erupts

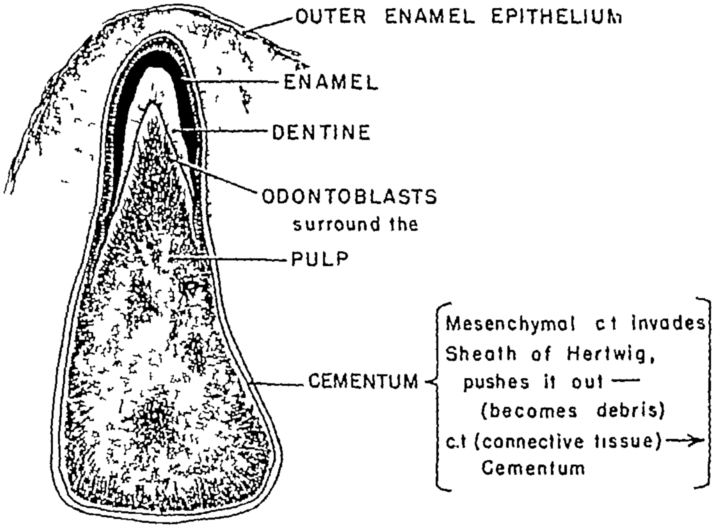


Fig 6

The process of development diagrammatically represented in Figs 1 through 6 can be reviewed in photomicrographs made from serial sections of a fetal upper jaw This fetus had a crown-rump length of 100 mm , representing about the fourteenth week of development

The gradual thickening of oral epithelium is first observed (see Fig 7) with the "bud" stage progressing to form a dental lamina The latter progresses to the "cap" stage (see Fig 8), and the next figure (see Fig 9) shows a beginning "bell" stage

These are tissues, therefore, whose histodifferentiation is not completed until after all permanent teeth have erupted There is thus a long postnatal period in which growth disturbances may result in tumor and cyst formation

Such growth disturbances may be due to inflammatory processes or nutritional deficiences, but especially neoplasia by the developing tissues or the epithelial debris

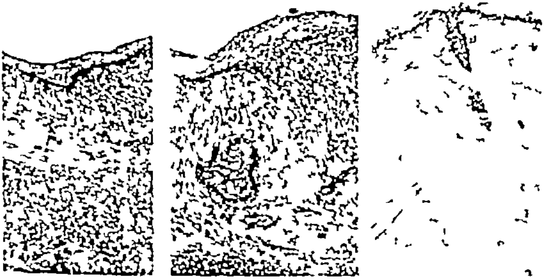


Fig. 7 Fetal jaw Oral epithelium and "bud" stage.

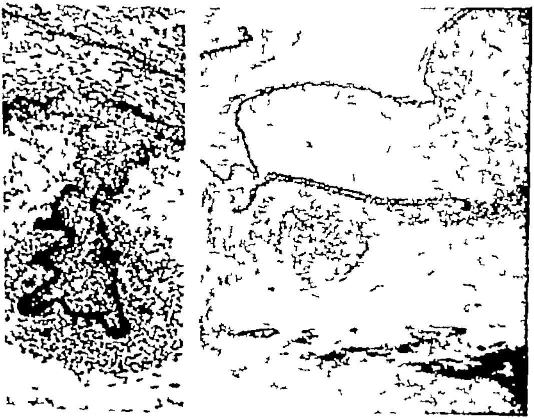


Fig. 8 Fetal jaw Dental lamina and "cap" stage.

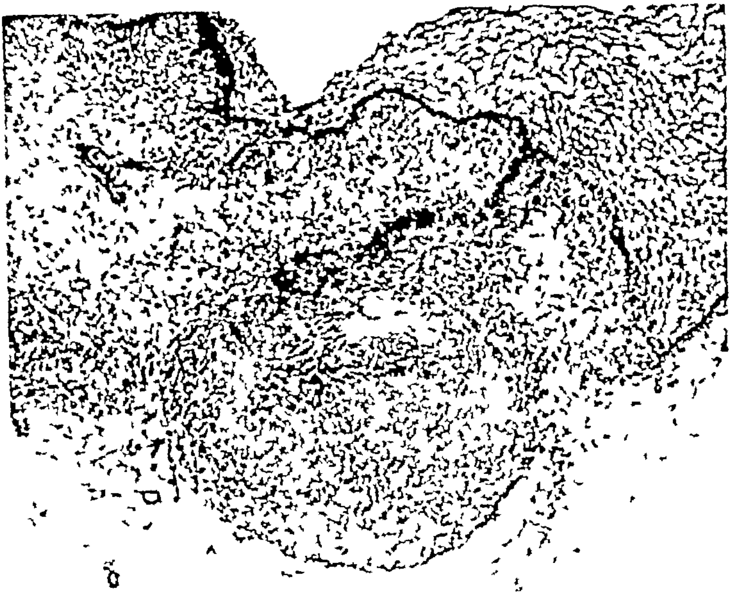


Fig 9 Fetal jaw Beginning bell stage

POTENTIAL MALFORMERS

Knowing the embryological and developmental components, the potential malformers can be tabulated (see Table 1) First, the epithelial debris includes that of the dental lamina, and the outer enamel epithelium and sheath of Hertwig of the enamel organ Second, the dental follicle, the potential tooth, includes the epithelial enamel organ, and the mesothelial dental papilla and cementum Components of the enamel organ are the epithelial debris of Malassez, the ameloblasts, and the stellate reticulum Components of the dental papilla include the odontoblasts and the mesenchymal tissue proper

CLASSIFICATION AND DISCUSSION OF ODONTOGENIC CYSTS AND TUMORS

Knowing the potential malformers the odontogenic cysts and tumors can be classified (see Table 2) and after each list the structure of origin, *i e*, the structure whose maldevelopment or neoplasia resulted in the pathological entity

Basically there are two types of odontogenic cysts the follicular cyst and the radicular cyst. The follicular cyst, as its name implies, arises from the dental follicle or sac, and specifically from the sac like enamel organ with its internal stellate reticulum Many of the standard ear, nose and throat textbooks lack a clear definition of follicular and dentigerous cysts As indicated in Table 2, the follicular cyst may be either simple or it may be dentigerous, *i e*, bearing a tooth Knowing the embryology, the enamel organ can be visualized early in its development, dilating and becoming a simple, follicular cyst, or doing so at a later stage, after a tooth has partially or completely formed, and, therefore, forming a *dentigerous* follicular cyst

TABLE 1.

POTENTIAL MALFORMERS

1 EPITHELIAL DEBRIS
- a Dental Lamina
- b Enamel Organ (Paradental debris of Malassez)
  - —Outer Enamel Epith.
  - —Sheath of Hertwig

2 DENTAL FOLLICLE (potential tooth)
- a Enamel Organ (Epithelial)
  - —Epith Debris
  - —Ameloblasts
  - —Stellate Reticulum
- b Dental Papilla (Mesothelial)
  - —Odontoblasts
  - —Mesenchymal tissue
- c. Cementum (Mesothelial)

Follicular cysts are usually of the dentigerous variety, frequently associated with impacted lower third molars in young people They may, however, occur in the maxilla Modifying adjectives such as central or lateral refer to the position of the cyst in relation to the contained tooth crown They may be multiple

TABLE 2

CLASSIFICATION OF ODONTOGENIC CYSTS AND TUMORS

	ORIGIN
A CYSTS	
1 Follicular	Enamel Organ-stellate reticulum (epith)
a Simple	
b Dentigerous (L dens—tooth) (genere—to bear)	
central	
lateral	
multiple	
2 Radicular (root) (England—dental cyst)	Paradental debris of Mallassez (Sheath of Hertwig plus outer enamel epith.)

CLASSIFICATION OF ODONTOGENIC CYSTS AND TUMORS

(cont d)

	ORIGIN	
B TUMORS		
1 Adamantinoma (ameloblastoma)	Enamel Organ (epith) (—no enamel found)	
2 Odontomas		
a Enameloma	Inner Enamel epith	
b Dentinoma	Dental papilla	mesoth
c Cementoma	C T	
d Mixed (ectod and mesod)	Varying parts of Dental Follicle	

QUALIFYING TERMS

Soft
Calcified
Complex

Compound (with teeth)
Geminated (L geminatio — a doubling, twins)
Cystic

The radicular cyst, as its name implies, occurs in the area of the root of a tooth, usually a diseased or devitalized tooth The epithelial debris of Malassez, particularly the sheath of Hertwig, appears prone to inflammatory disturbance and cyst formation

As indicated in Table 2, these cysts are of epithelial origin, embryologically from the parent stratified squamous oral epithelium Their lining, therefore, is stratified squamous epithelium, occasionally flattened down by the pressure of the transudate or exudate filling the cyst into a simple, pavement epithelium.

The odontogenic tumors also include two main types one is the adamantinoma or ameloblastoma, the other, the various odontomas or "tooth-tumors"

The adamantinoma arises from the enamel organ, an epithelial structure It retains the undifferentiated character of this structure in that no enamel is found in the tumor tissue. This contrasts with the enameloma As previously noted, the nuclei of the adamantoblasts, or ameloblasts, are toward the side of the stellate reticulum. This appearance of "nonbasal" nuclei is retained in the adamantinoma It is sometimes described as resembling a gland turned inside out

In one series of 379 cases of adamantinoma, 70 per cent appeared in patients in the age group of 10 to 35 years.[2] They were equally divided between the sexes Adamantinomas occur much more commonly in the mandible than in the maxilla

The local invasiveness of adamantinomas has been repeatedly emphasized, and deservedly so

The odontomas include so-called enamelomas dentinomas, cementomas and tumors of mixed tooth constituents The enamelomas are of epithelial origin the dentinoma and cementomas, mesothelial, the mixed odontoma is the most common. Often the label used merely indicates the predominant constituent. Various qualifying terms are used to describe lesser characteristics

TREATMENT

Basically, the treatment of odontogenic tumors and cysts consists of surgical excision This should include the offending tooth or teeth, in the case of dentigerous or radicular cysts Simple marsupialization of the cyst, with or without a plastic button or similtar prosthesis to keep the orifice open, has been advocated, without the removal of the cyst lining The claim is made that the cyst cavity will then granulate in Such occurrence would be a unique phenomenon in the human body Surgical diathermy to the bony surfaces of the defect helps insure complete removal of the lining membrane

Of the odontogenic tumors, excision and cure is fairly readily obtained except in the case of adamantinomas The invasiveness and locally-malignant nature of the latter cannot be overemphasized In this condition surgical excision must be radical in nature, with a wide margin The following case report illustrates this

ADAMANTINOMA REPORT OF A CASE

B P, a very lovable little four year-old boy, was first seen in the Stanford Ear, Nose and Throat Clinic in March, 1951, complaining of displacement upward of the left eye of four months' duration. Two weeks before coming to the clinic, X ray examinations had revealed an abnormality of the left maxilla Additional history is not pertinent

On examination the only positive findings included a slight proptosis of the left eye, equal palpebral fissures, but a slightly higher position of the left cornea compared to the right

Further X ray studies (see Fig 10) revealed a mass in the left antrum absence of much of the lateral and inferior walls of the antrum as well as the floor of the left orbit Tooth structures were noted in the mass

On exploration via a Caldwell Luc approach, the tumor seemed to have a capsule which could be separated from bone where present and from residual periostum where the bone had been destroyed Frozen sections determined the diagnosis of adamantinoma (see Fig 11) (The resemblance of this tissue, with its stellate reticulum and darker epithelial elements, to the developing tooth structures shown in Figs 8 and 9, is striking) An inferior meatal window was fashioned and the incision closed

Because of the notorious difficulty of complete removal of this type of tumor, the patient was then presented before the Stanford Tumor Board for advice as to the best therapeutic course The Board advised multiple biopsies of the walls of the operative defect for evidence of persistent tumor It was hoped that the left eye could be spared

Fig 10 Destruction of walls of left antrum by adamantinoma.

Fig 11 Adamantinoma.

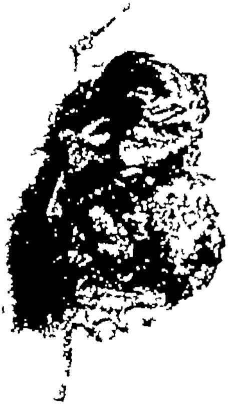


Fig 12 Orbital contents and maxilla removed en bloc.

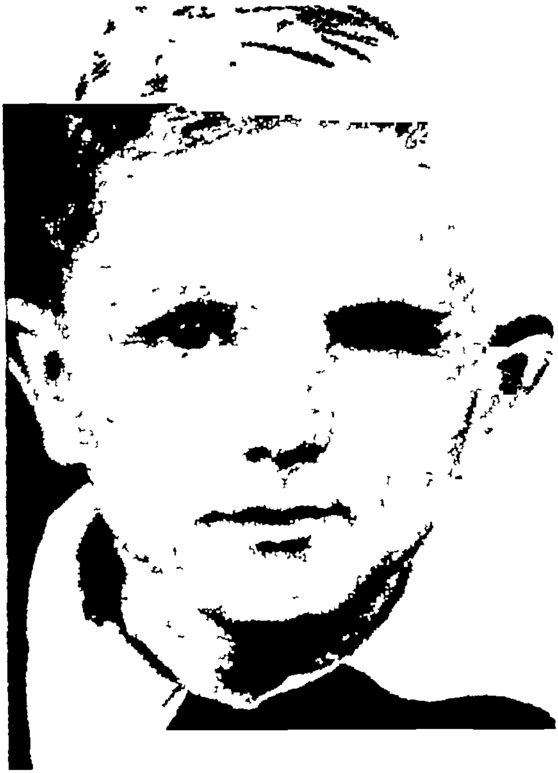


Fig 13 Patient one year postoperative

The surgical cavity was therefore re-entered and multiple biopsies taken. These showed extension of the adamantinoma to the lateral wall floor and medial wall of the antrum and involvement of the left peri orbita both anteriorly and posteriorly The Tumor Board therefore recommended radical exenteration including the left orbital contents as necessary for cure

The entire left maxilla part of the zygomatic bone the pterygoid process of the sphenoid and the entire orbital contents were then resected en bloc (see Fig 12) The incision circled the palpebral fissure extended downward along the side of the nose then along the columella separating the upper lip After removal of the specimen the eyelids were sutured together and the cheek flap and part of the surgical cavity were lined by a split thickness graft from the abdomen held in place by sponge rubber packing.

Postoperatively a dental prosthesis was fashioned to close the palatal defect. It has been modified several times with the growth of the patient. He is now one year postoperative (see Fig 13) with as yet no sign of persistent or recurrent tumor

SUMMARY AND CONCLUSIONS

A knowledge of the terminology, nosology and embryology of tooth structures is essential for the understanding of odontogenic tumors and cysts. This basic information has been reviewed, and correlated with the formation, diagnosis and treatment of such tumors and cysts The individual anlage have been tabulated Therapy has been discussed, and the need for radical surgery for cure of adamantinomas has been stressed A case report illustrates this type of therapy

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TRACHEOTOMY IN BULBAR POLIOMYELITIS

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Nearly all of the deaths in poliomyelitis occur in patients with bulbar involvement, therefore, any improvement in the management of this phase of the disease assumes great importance During the past decade tracheotomy has been performed in hundreds of cases of bulbar poliomyelitis, and the literature now contains many favorable reports of its use[1] There are other workers, however, who have had wide experience with this disease who contend that they have not seen cases requiring tracheotomy[2,3] Even among those who advocate the operation there is a difference of opinion as to its indications and the time when the procedure should be carried out[1]

Much of the confusion that exists is due to the fact that the pathology and pathological physiology of this disease is not too well understood The problems involved and the literature have been reviewed quite completely by Galloway,[1b,1d,1i] Baker,[4] Cummings,[1j] Mitchell and Hill[1g] and Priest *et al*[1c,1k]

In order to understand the clinical manifestations of the disease the following classification (Galloway and Seifert[1d]) is presented

1 Spinal Diaphragm and intercostal muscle paralysis

2 Bulbar paralysis Involvement of the swallowing mechanism and resultant accumulation of secretion, food and fluids, and vomitus in or over the airway

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Editor's Note This ms received in Laryngoscope Office and accepted for publication April 7 1952

3 Bulbar spinal A combination of the above (1 and 2)

4 Other disturbances in rhythm and depth of respiration (so-called poliomyelitic encephalitis)

The use of tracheotomy in bulbar poliomyelitis is based upon the concept (Galloway[1b]) that most of the severe central effects result from anoxia and carbon dioxide accumulation due to secretional obstruction of the air passages The direct action of the virus on the central nervous system is considered less important than the effect of anoxia Tracheotomy is resorted to in order to clear the airway and relieve obstruction.

Brown[8] states that "we agree in Minneapolis as to the extreme importance of anoxia and maintenance of an adequate airway in poliomyelitis, however, we disagree in part with Dr Galloway We have seen cases showing definite and severe inflammatory involvement of the respiratory center and the circulatory center in the medulla. These cases have been studied histologically and have been reported in the literature From 1946 to 1948, we saw 318 cases of bulbar poliomyelitis with a mortality of 34 2 per cent, in spite of every effort made on our part to maintain an open airway"

The following are Brown's mortality statistics

Pure cranial nerve involvement—mortality 5 6 per cent.

Respiratory center involvement—mortality 70 per cent

Circulatory center involvement—mortality 85 per cent.

Relatively pure encephalitic symptoms—mortality 0 3 per cent.

Bulbar with involvement of diaphragm and intercostals—mortality 54 per cent

It appears from the above discussion that bulbar poliomyelitis is not a simple disease entity Many cases may be problems solely of respiratory obstruction, but others will show the more serious symptoms of medullary center involvement.

The indications for tracheotomy in poliomyelitis according to Galloway and Seifert[1d] are

1. Progressive anoxia with secretion in the upper airway
2. Unconsciousness or pronounced restlessness in a patient who does not respond to other treatment within a few minutes
3. Pronounced restlessness or stupor in a patient in a respirator, even if the paralysis is apparently of a spinal type
4. Fluid accumulation not otherwise certainly taken care of in a patient who requires a respirator
5. Bilateral paralysis or spasm of vocal cords
6. Rapidly progressive bulbar symptoms
7. Grave signs of vasomotor failure
8. Untrained or inefficient attendants, inadequate equipment or poor cooperation of the patient, with doubt that the airway will be kept constantly free of secretion

Advantages of the use of tracheotomy in the care of these patients are *1* they can be placed in a respirator and will synchronize successfully (Galloway and Seifert[1d]), *2* clearing of secretions from the lower airway is facilitated, and *3* oxygen under positive pressure which has been humidified can be delivered through the tracheotomy tube This delivery can be synchronized with the respirations and even with the respirator when necessary

The following cases represent our experience with tracheotomy in poliomyelitis at the Kingston Avenue Hospital in the years 1949 and 1950 During those two years there were 1,237 patients admitted with poliomyelitis Two hundred and three patients had bulbar or bulbar-spinal involvement and all of the deaths (89) occurred in this group The mortality rate for the patients with bulbar involvement was 43 8 per cent and the mortality rate for all the cases (1,237) was 7 2 per cent

Six tracheotomies were performed, and five of those operated upon died The case reports of the six tracheotomized patients are presented on next page

CASE REPORTS

Case 1 A 16-year-old white male was admitted on Sept. 3 1949 with a history of vomiting headache and stiffness of the neck of 12 hours duration. Examination revealed a slight nuchal rigidity and bilateral hamstring spasm Spinal tap revealed 495 cells He developed a rapidly ascending paralytic involvement, so that on Sept. 4 there was paralysis of both lower extremities and the intercostal muscles. A slight nasal twang was noted. On Sept. 5 he began to vomit continuously and became lethargic Frequent suctioning was required A Levine tube was passed and he was placed in an oxygen tent, and a tracheotomy was then performed At the completion of the operation the color of the patient was described as 'poor" and in spite of oxygen suction and stimulants he never improved He expired 15 minutes after the completion of the tracheotomy

Autopsy Findings There is a tracheotomy wound in the midline of the neck extending to between the second and third cartilages The tracheal mucosa about the wound is reddened Within the tracheal and bronchial passages there is a moderate amount of gastric contents The right lung weighs 290 gm the left 250 gm. Both lungs are voluminous hypercrepitant and emphysematous They are pink in color and show a few patches of atelectasis bilaterally at the hilum. The diagnosis was emphysema and atelectasis of the lungs.

Case 2 A five-year-old white male was admitted on Sept. 12 1949 with a two-day history of sore throat, fever and vomiting. On admission his temperature was 102° F He had a rigid neck, bilateral hamstring spasm occasional upper extremity tremulousness and a suggestion of a nasal twang Spinal fluid showed 87 cells On the day after admission he developed a large amount of mucus in the throat, respiratory distress and tremor There was reddening of the pharynx with pooling of mucus The uvula deviated to the left and the right palatine arch was widened Direct laryngoscopy revealed abductor weakness of the left vocal cord A tracheotomy was performed At the completion of the operation the patient's condition was good His color was good and there was no dyspnea. Within five hours however there was rapid deterioration of his condition with the development of quadriplegia intercostal and diaphragmatic paralysis. He was placed in a respirator and oxygen tent. There was no difficulty in keeping the tracheotomy tube free from secretions. Despite this therapy he went into a coma, had a convulsion and expired about eight hours after the tracheotomy

Autopsy Findings Right lung weighs 220 gm. and the left weighs 14[illegible] gm. Both lungs show hemorrhagic areas scattered throughout (left more than the right) There is a small amount of aspirated gastric contents in the lower trachea and bronchi

Case 3 A 19 year-old white male was admitted on Sept. 17 1949 with an onset three days previously of sore throat headache and nausea. Vomiting malaise and difficulty in swallowing commenced the next day At the time of admission he was vomiting and his temperature was 102° F There was a nasal twang and slight deviation of the tongue and uvula to the right. There was no stiffness of the neck. Spinal tap was done and the cell count revealed 95 cells Later on the day of admission he developed difficulty in breathing and became very apprehensive His face was markedly suffused and dusky There was pooling of mucus in his throat. Tracheotomy was immediately performed His color was good at the completion of the procedure About two hours later however he developed irregular respirations (like Cheyne-Stokes) and again became restless and apprehensive His temperature was 102 6° F blood pressure 130/90 and the pulse was of good quality but rapid The tracheotomy tube was not obstructed and nothing was obtained on suctioning His skin became cold and mottled Despite oxygen and supportive treatment, he expired about 12 hours after the operation No autopsy was obtained

Case 4 An eight year old white male was admitted on Sept 24 1949, with a four-day history of nausea vomiting and fever For two days he had had back and neck spasm He had a nasal twang for one day Examination revealed a rigid neck a nasal twang and deviation of the uvula to the right. On the following day his condition was worse He showed weak intercostal function and the respirations were rapid and shallow but regular in rhythm There was left deltoid weakness and a right facial paralysis He developed difficulty in swallowing and clearing the hypopharynx of the rapidly accumulating secretions He was oriented but lethargic A direct laryngoscopy was performed and an accumulation of secretions in the epiglottic region was noted There was a paralysis of the right vocal cord An airway was introduced, and a tracheotomy was performed over it The postoperative course was smooth There was no further respiratory difficulty Blocking of the tracheotomy tube was started one week after the operation, and he was decannulated on the eleventh postoperative day On Oct 24, 1949 (one month after admission) he was discharged to an orthopedic hospital for further treatment of a left deltoid weakness Except for this, however, he was well and the pharyngeal and palatal muscles were functioning normally

Case 5 A nine year old white male was admitted on Sept 30 1949, with a history that two days previously he had been beaten by three boys The following day he was dizzy and nauseated On the day of admission he was incoherent he had vomited and had been unable to sleep His temperature was 104 2° F and he had nuchal rigidity, a right facial paralysis palatine paralysis with inability to swallow deviation of the tongue to the left, weakness of the right leg and absent abdominal reflexes There was pooling of secretions in the pharynx, he was unable to speak and was periodically cyanotic No spinal tap was performed A direct laryngoscopy was done and excessive secretions were found in the hypopharynx. The glottic chink was half open with no abduction and sluggish adduction of the vocal cords An airway was inserted and tracheotomy was performed He was placed in an oxygen tent. Two hours postoperatively he seemed more responsive and his general condition was somewhat improved Eight hours after the tracheotomy he became worse, he was cyanotic and the respirations were irregular and shallow He did not respond to commands His face was ashen, the lips and fingers cyanotic and a mottled erythema was seen over the trunk His blood pressure was 120/80 and his pulse was 130 He expired 13 hours after the tracheotomy No autopsy was obtained

Case 6 An eight year old white male was admitted on Aug 14, 1950 with a one-day history of headache nausea and vomiting A nasal twang was noted on the day of admission He had a temperature of 101 2° F good color and normal respirations The palatal and pharyngeal muscles were immobile and there was regurgitation through the nose Spinal tap showed 222 cells The following day the patient had inspiratory stridor and difficulty keeping the pharynx clear of secretion He appeared toxic and had anxious facies Direct laryngoscopy revealed secretions in the hypopharynx There was a good airway and no vocal cord paralysis It was felt that the secretions were causing a spasm of the glottis An air way was inserted and a tracheotomy was performed over it. He withstood the procedure well and his breathing was made more comfortable His pulse became stronger and he was able to doze off for a while About five hours after the completion of the tracheotomy however he became cyanotic his pulse became rapid and thready and his temperature began to rise. His airway was clear Despite oxygen and supportive therapy his temperature went up to 108° F and he expired about seven hours after the operation

Comment The patient in Case 1 was operated upon in the terminal stage of his illness when there was spinal, cranial nerve, circulatory center and encephalitic involvement Autopsy revealed evidence of aspiration of gastric contents Certainly if tracheotomy is expected to help, it should be done before the patient is moribund

The other four patients who died were operated upon early while their general condition was good In all of them there was pooling of secretions requiring frequent suctioning to prevent obstruction of the airway and hypoxia There was cranial nerve involvement, as indicated by palatal paralysis, and in some of the cases pharyngeal paralysis was recorded Two of these patients had vocal cord paralysis, one unilaterally and the other bilaterally In one patient the stridor appeared to be due to spasm of the vocal cords No technical difficulty was encountered during the operations as they were all done in patients who were not in a respirator Some of the tracheotomies were done over an airway In none of these six patients did pneumothorax or mediastinal emphysema develop postoperatively The immediate relief of dyspnea cyanosis and restlessness after the operation proved that the obstruction had been overcome No difficulty was encountered in keeping the tracheotomy tube clear of secretions and in none of these patients were there excessive secretions in the trachea and bronchi after the operation

There was evidence of cardiovascular center involvement in four patients (Cases 1, 2, 3 and 6) and respiratory center involvement in one (Case 5) In Case 4 the disease was limited to spinal and cranial nerve involvement and we believe that tracheotomy saved this patient's life Chart I is a summary of the findings in the six tracheotomized patients

Brown and Baker[6] state that "the involvement of the respiratory regulating center generally develops somewhat later in the illness than do the cranial nerve palsies" It would seem to us, therefore, that in the patients upon whom we operated early we provided a good airway and oxygenation, but we did not alter the effect of the virus on the medullary centers, as suggested above, and this ultimately led to the death of the patient On the other hand, had a tracheotomy not been performed, these patients would have probably died from the effect of anoxia and carbon dioxide accumulation before the full effect of the virus could be brought to play upon the medullary centers

Only one of these patients was placed in a respirator postoperatively Although oxygen was given to these patients after the operation, none was administered by positive pres-

CHART I

SUMMARY OF TRACHEOTOMIZED CASES

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Lived or Died	Died	Died	Died	Lived	Died	Died
Day of Disease Before Operation	3rd	3rd	4th	5th	4th	3rd
Bulbar (B) or Bulbar-spinal (BS)	BS	BS	B	BS	B	B
Palatal Paralysis	Yes	Yes	Yes	Yes	Yes	Yes
Pharyngeal Paralysis	?	?	?	Yes	Yes	Yes
Vocal Cord (abductor) Paralysis U-unilateral B-bilateral	*	U	*	U	B	None
Spasm of Vocal Cords	*	No	*	No	No	Yes
Pooling of Secretions	4+	4+	3+	4+	3+	4+
Condition at Time of Tracheotomy	Poor	Good	Good	Good	Fair	Good
Condition Immediately After Tracheotomy	Expired	Good	Good	Good	Fair	Good
Time of Onset of Deterioration Post-operatively (hours)	Immediately	5	2	----	8	5
Expired Post-operatively (hours)	¼	8	12	----	13	7
Type of Death CV- Cardiovascular failure R- Respiratory failure	CV	CV	CV	----	R	CV

*--Not Examined

sure through the tracheotomy tube. On the basis of our present experience we can only speculate as to whether our results would have been better if the respirator and humidified oxygent under positive pressure had been used in the patients who died.

The survival rate of 16 6 per cent (one out of six) for the patients with bulbar poliomyelitis undergoing tracheotomy was lower than that for all the patients in this series with bulbar involvement, which was 57.2 per cent (114 out of 203) These figures merely indicate that the more desperately ill patients are operated upon, and a fair percentage of those who survive owe their lives to the operation It would be entirely wrong to attribute the increased mortality rate to the tracheotomy itself Chart II indicates that the experience of other workers coincides with ours

CHART II.

MORTALITY RATE

	Bulbar Cases	Deaths	Number of Tracheotomies	Deaths
Miller and Buck[1h]	388	101	198	77
Mitchell and Hill[1g]	39	4	10	4
Strobel and Canfield[1f]	17	6	10	5
Priest *et al*[1k]	169	65	56	31
Friedman and Gilbert	203	89	6	5

SUMMARY

1 Tracheotomy may be a life-saving procedure in bulbar poliomyelitis.

2 On the basis of our limited experience, we believe that the operation is indicated in the presence of

a. Bilateral vocal cord paralysis.

b Secretion obstructing the airway especially when associated with unilateral vocal cord paralysis or spasm of the larynx

3 It is preferable to perform the operation before there is evidence of medullary center involvement.

4 In spite of an early and well-functioning tracheotomy, involvement of the medullary centers, with respiratory and circulatory failure, does follow

5 This report covers our experience with six patients with bulbar poliomyelitis who underwent tracheotomy, five of whom died We believe that the operation saved the life of the patient who survived

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17 Pine Street

1404 President Street

LARYNGOSCOPE MODIFIED FOR OXYGEN INSUFFLATION †

MERRILL W MICHELS, M D,
Oakland, Calif

The modification of the standard Jackson and Holinger laryngoscope with a channeled tube* so that oxygen can be insufflated during laryngoscopic procedures has provided a much more useful instrument

The coincidental use of oxygen with sodium pentothal and curare in performing laryngeal operations prevents hypoxia and allows for greater latitude of procedure. Good preliminary anesthesia is essential, morphine and either atropine or scopalamine should be administered prior to pentothal to check the manifestations of parasympathetic stimulation such as laryngeal spasm or cough. Sodium pentothal produces unconsciousness but does not inhibit reflex muscular activity, this reflex is depressed by preliminary medication. The reflex activity of the larynx can be satisfactorily blocked by the use of a topical anesthetic as pontocaine 2 per cent. Since the margin between production of relaxation and respiratory paralysis is narrow with curare, artificial respiration with oxygen is often necessary

The direct channeling of oxygen to the glottis while doing laryngoscopic procedures has obviated many of the disagreeable features of pentothal and curare.

It has been my practice to introduce routinely an endotracheal tube on completion of the laryngoscopic work and to

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These instruments were specially made by George P Pilling and Son Co Philadelphia, Pa.

†From the Department of Otolaryngology Permanente Hospitals.

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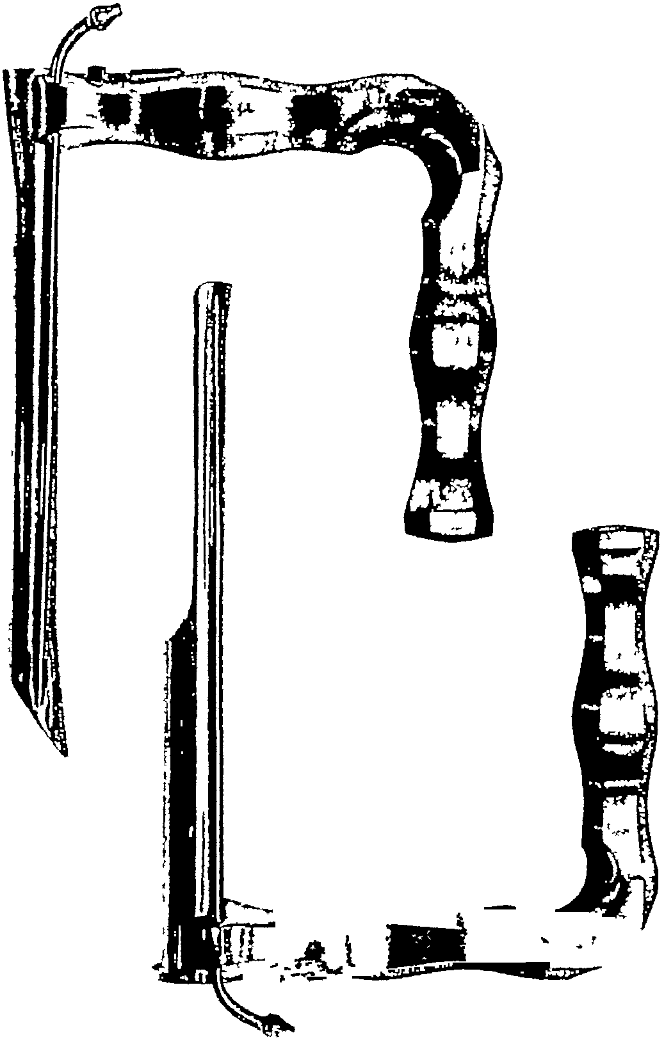
leave it *in situ* until the patient has well reacted The help of a competent anesthetist is a requisite



AMERICAN MEDICAL WRITER S ASSOCIATION

Dr Walter C Alvarez, of Chicago, nationally known medical editor, author and teacher, has been honored as recipient of the first Honor Award to be given by the American Medical Writer's Association The award, consisting of a gold medal and certificate, was presented to Dr Alvarez at the dinner on the occasion of the ninth annual meeting of the association at the Jefferson Hotel, St Louis, Oct 1 Dr Alvarez is Editor in-Chief of *Modern Medicine* Professional Lecturer at the University of Illinois College of Medicine

The Distinguished Service Award of the association was given to Dr Harold Swanberg of Quincy, Ill

MISSISSIPPI VALLEY MEDICAL SOCIETY

Dr Philip S Hench, of Rochester, Minn, internationally known internist and research worker, has been honored by the Mississippi Valley Medical Society as its Honor Award recipient for 1952 The award, consisting of a gold medal and a certificate, was presented Dr Hench at the banquet on the occasion of the seventeenth annual meeting of the society at the Jefferson Hotel St. Louis, Oct 2 Dr Hench is Professor of Medicine, Mayo Foundation, University of Minnesota, and a 1950 Nobel Laureate in Physiology and Medicine

Dr Willard O Thompson of Chicago Ill, was given the Distinguished Service Award of the society

In Memoriam

MOSES DAVID LEDERMAN, M D ,

1868-1952

With the passing of Dr M D Lederman, of New York City, on Sept 7, 1952, the medical profession and the community lost a pioneer physician, a gifted author and editor and a great personality

Dr Lederman received his M D degree from the medical department of the University of Pennsylvania in 1889, and his postgraduate study was continued in the clinics of London, Rome, Vienna, Berlin and Egypt Shortly after completing his studies he became associated with Seiler (Seiler's Cartilage and Seiler's Tablets) and within two years he was entrusted with the major responsibilities both at Dr Seiler's office and at several of the most important otolaryngological clinics in New York City

His professional development was rapid Very early in his career he revealed unusual surgical skill and by the turn of this century he was recognized as an outstanding leader in his specialty About this time he was appointed Associate Professor of Otolaryngology at the Poly-Clinic Hospital and at the same time served as Chief of Clinics at Manhattan Eye and Ear Infirmary and at Mount Sinai Hospital

In 1895, he became a charter member of the American Laryngological, Rhinological and Otological Society and he was the first otolaryngologist to be invited to the editorial staff of THE LARYNGOSCOPE when it was established in 1896, in which capacity he served for 56 years He was an ardent supporter of this journal throughout his professional life, and his long association with it was a source of great pride to him and of great service to the journal

In 1908, Dr Lederman was chosen Senior Otolaryngologist to Lebanon Hospital and served on its medical board as member, officer and finally as consultant until his death He derived great satisfaction from his association with this hospital for these many years, and he counted every member of the medical staff and Board of Managers as his friends

In an era antedating specific drugs and antibiotics he developed techniques and methods in the management of suppurative ear conditions and described these methods in numerous publications He was in constant correspondence with specialists all over the country

Dr Lederman belonged to a generation of leaders, trail blazers and teachers who made worthwhile contributions to medical history and we are indebted to him for his share in these contributions

It has been said that every practicing physician renders psychiatric services by his manner and personality, and Dr Lederman's personality was most engaging and genial

Tall, distinguished looking, with resonant voice and a ready smile, he was popular with all he met his love for his fellow men and his cheerful disposition were very obvious, and people were readily attracted to him. He had a word of cheer for everyone, and on all occasions his warm-heartedness was evident in his speech and gesture. He never grew old in spirit, and he was especially popular with the young

On his visits to the hospital in recent years he was the center of attraction He was an excellent raconteur and you could see him surrounded by a group of eager listeners, both young and old recounting most vividly some incident which he said, occurred in his long and active career These events were inexhaustible and were rarely repeated in the same way except for the twinkle in his eye and the dimple in his left cheek These stories were frequently punctuated with a chorus of laughter His subtle sense of humor was used effectively to dissipate tension or to create an atmosphere of hopefulness with his patients

At the operating table he was a skillful technician and an excellent teacher To the bedside he brought comfort and cheer, to the younger physicians he gave encouragement and inspiration, and to his colleagues, warmth, friendship and understanding

We shall remember him as a warm-hearted friend and as a kind, considerate fellow-worker His absence will be keenly felt

D G

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION.

October 1, 1952

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Radioear Permo-Magnetic Multipower, Radioear Permo-Magnetic Uniphone, Radio Ear All Magnetic Model 55, Radioear Model 62 Starlet, Model 72

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Sonotone Professional Table Set Model 50

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THE

LARYNGOSCOPE.

VOL. LXII NOVEMBER, 1952 No. 11

REVIEW OF AVAILABLE LITERATURE ON THE PHARYNX AND PHARYNGEAL SURGERY FOR 1951 *

FRANCIS E. LEJEUNE, M.D., and MILES LEWIS, M.D.,
New Orleans, La.

ANOMALIES

Schmidt[1] presents a case of bilaterally elongated styloid processes in a professional singer. The patient had difficulty in reaching and holding high notes and had some pain and discomfort in the throat. The diagnosis was made by palpation and confirmed by Roentgenography. At operation the stylohyoid ligament was found to be ossified; exposure through the tonsillar fossa was obtained, and one inch of the elongated process was removed on each side. Following this procedure the patient's symptoms cleared up.

Schmidt also describes the embryologic development of the styloid process, which is intimately connected with the hyoid bone. The average styloid process is 2.5 cm. long; longer ones are encountered in only 4 per cent of cases. Various diagnostic points are presented, but it is the opinion of the reviewers that intraoral palpation is unexcelled.

Longacre[2] presents a case of an infant three months old with congenital atresia of the fauces which he believed to be due to failure of rupture of the buccopharyngeal membrane. The defect was corrected surgically, and the child was in excellent health at the time of this report.

From the Department of Otorhinolaryngology, Ochsner Clinic and Tulane University of Louisiana, School of Medicine, New Orleans.

Editor's Note: This ms. received in Laryngoscope Office and accepted for publication Oct. 3, 19—

Numerous variations in surgical technique for the correction of atresia of the posterior nares have been tried, most involve some destruction of the soft parts and removal of part of the nasal septum Beinfield[3] describes a comparatively simple technique which proved effective and nondestructive in one case of unilateral bony atresia of the posterior nares An incision is made along the floor of the nose and is extended up onto the septum just inside the cut nares The mucoperiosteum is elevated from the floor of the nose and septum and from the anterior surface of the bony atresia The bone closing the posterior nares is then removed with a small mastoid gouge The mucoperiosteum is replaced and a stellate incision made through the nasal and nasopharyngeal mucosa over the posterior choana A large rubber tube is passed through this opening and maintained in place five days Beinfield admits that it is too early to evaluate the final result, but he points out that the principle "is sound and should work out well"

A rather complete discussion of atresia of the posterior nares is included

DISEASES

Thibaudeau[4] reports an interesting case of atlantoaxial subluxation which was due not to trauma but to an acute pharyngeal infection complicated by catarrhal otitis in a child nine years old Penicillin therapy cured the torticollis and a Roentgenogram taken seven days after the first film showed normal bony structure and articulations

Segundo and associates[5] encountered a syndrome characterized by paralysis of the last four cranial nerves described in 1864 by Hughlings Jackson The most frequent causes of such symptoms are malignancies of the nasopharynx or base of the skull, trauma, particularly military injuries, and occasionally inflammatory infections involving the base of the skull or lateral adenopharyngeal wall A case is reported in which the last four cranial nerves were paralyzed, and examination of the patient finally established existence of a lateral pharyngeal abscess with extension to the base of the skull

Administration of penicillin and streptomycin controlled the infectious process and resulted in gradual disappearance of the paralysis.

Barton[6] believes that subacute thyroiditis as a cause of sore throat is often overlooked by the practicing physician. He has noted that the sensation of a lump in the throat is most often due to thyroid disease, although this has not been our experience A brief discussion of hoarseness in thyroid disease is given

Cheney[7] has made a study on the prevention and treatment of colds over a period of 20 years in 2,667 University of California students For convenience the students were divided into three groups of estimated natural resistance to infection Few conclusions could be drawn from the study Some patients with severely deviated septums had no colds, whereas others with no mechanical defects had frequent colds The best results in decreasing the number of colds were obtained by combined medical, allergic, and ear, nose and throat therapy

In a discussion of the structure and function of the upper respiratory tract and pharynx, Cawthorne[8] shows that the lymphoid elements of Waldeyer's ring serve to filter and sample bacteria and viruses passing over them and that some antibodies may be elaborated in this tissue in defense against infection The pathogenesis of the common cold is presented The possible relationship between the development of bulbar poliomyelitis and recent operations on the tonsils and adenoids is still not known, but it is believed that until more is known of a possible relationship, tonsillectomy and adenoidectomy should not be done when there is a high incidence of poliomyelitis in the community

Brunner,[9] in reporting a most interesting case of eosinophilic granuloma of the mouth, pharynx and nasal passages, expresses the opinion that the lymphatic tissue of the upper respiratory and digestive tracts does not become frequently involved in chronic systemic disease of the hematopoietic apparatus The opinion is correct if only gross changes of the lymphatic tissue, such as enlargements or ulcerations, are considered, however, microscopic changes are frequently encountered Brunner briefly reviews the findings in Hodgkin's disease in the respiratory and digestive tracts and then reports in accurate detail a 12-year observation on a most interesting case in which the symptoms were suggestive but not diagnostic of Hodgkin's disease The persistent enlargement of various groups of lymph nodes in the mouth, palate, pharynx and nose presented baffling problems Tissue eosinophilia was present and the eosinophile count in the blood was 67 25 per cent A thorough discussion of Hodgkin's disease, incorporated in this article, adds to its interest Because the case would not conform to the pattern of Hodgkin's, a diagnosis of eosinophilic granuloma was finally made

Asherson[10] discusses the three different syndromes associated with malignancy of the epipharynx and adjacent areas These are distinguished by the site of origin of the tumor The first is Trotter's syndrome, which is stated to be an endothelioma of the lateral wall of the nasopharynx beginning submucosally in the sinus of Morgagni It is manifested by deafness followed by pain and anesthesia in the third division of the Vth nerve Later, asymmetry of the palate due to infiltration of the palatine muscle occurs The second is the pterygopalatine fossa syndrome, which is caused by either a metastatic tumor in the pterygopalatine fossa or direct extension into the pterygopalatine fossa from a tumor of the posterior part of the lateral wall of the nose It is distinguished by primary pain over the second division of the Vth nerve, fullness of the temporal fossa and later by third division pain, deafness and paralysis of the palate Finally, the Jacod syndrome of the carrefour petrosphenoidale, which produces the symptoms of both Trotter's and pterygopalatine fossa syndromes, is caused by primary malignancy of the middle cranial fossa involving the second and third divisions of the Vth nerve at the foramen rotundum and ovale The anatomy and symptomatology of these syndromes are described in great detail and illustrative case reports are cited

Titche[11] reports a case of chronic peripharyngeal tuberculous abscess in a man 32 years old which was secondary to tuberculous adenitis of the anterior cervical lymph nodes It was successfully treated by aspiration and local and systemic administration of streptomycin and para aminosalicylic acid

Keratosis pharyngis has been reported in the past by many different names and most authors believe it is due to fungi of the Leptothrix species, however, Vaheri[1] who made a rather complete study of 21 cases involving principally the tonsils and the base of the tongue, found Leptothrix in no case Friedlander's bacillus and a streptococcus were most frequently noted In the cases in which tonsillectomy was done cartilage was commonly found in the tonsils Keratosis pharyngitis is believed to be a slowly progressive chronic, self limiting, inflammatory process Tonsillectomy is advisable when the tonsils are involved

Shnee[13] writes an all too short article on a tremendously interesting subject because of the bizarre symptoms which challenge and frequently baffle the diagnostic acumen of the clinician. Patients with paresthesia of the pharynx are frequently seen in the office and, according to Schnee, complain of soreness, dryness, burning, choking tightness, tickling, itching and even mild dysphagia Frequently no organic cause can be found to account for these symptoms The diagnosis is made by a process of elimination Consideration must be given to such possible causes as hysteria, neurosis anemia, hypochondriasis and the menopause

Schnee reports a case in which tightness of the throat, a sensation of a lump and difficulty in swallowing were the chief symptoms The only finding on clinical examination was a tender spot on the right side of the neck above the hyoid bone Injection of the superior laryngeal nerve on the right side relieved the symptoms for a period of two months When these recurred, incision in the neck over the tender spot disclosed an enlarged cervical gland pressing on the superior laryngeal nerve Two years after removal of the gland there was complete relief of symptoms The report of this case is considered important because it proves that frequently meticulous examination will indicate a diagnosis in an otherwise obscure condition which, because of lack of obvious disease, is too often called globus hystericus

After a brief discussion of pharyngeal infections, Folken[14] reports a case in a boy 14 years old, complicated by erosion of the internal jugular vein Despite vigorous attempts to control bleeding, repeated hemorrhages occurred, which proved fatal

During the summer of 1949 and 1950, David and associates[15] observed a group of children, mostly under five years of age, in Jacksonville, Fla, who presented a clinical picture of sudden illness with fever, usually of 48 hours' duration, malaise and anorexia Examination revealed vesicular or aphthous lesions of the soft palate and anterior faucial pillars The clinical course of the patients and the appearance of the lesions were strikingly uniform A viral agent pathogenic for suckling mice was isolated from throat secretions of 12 of 13 patients with this disease This viral agent was shown to be similar, but of a different serologic type, to the virus isolated in 1948 by Daledorf and Sickles and later designated as the Coxsackie virus Fortunately, the condition was self-limited, seldom lasting longer than two days, however, the ulcers sometimes persisted as long as seven days The isolation of the Coxsackie virus from all cases shows the existence of a definite relationship with the clinical disease described by David and associates

DIVERTICULA

Crile and Robnett[16] report 11 cases of pharyngoesophageal diverticulum treated satisfactorily by simple inversion of the sac Briefly the technique is as follows The incision is made in the usual manner The sac is dissected free up to its neck, a purse string is placed around the neck and the pouch is inverted into the esophagus An Ewalt tube is passed into the stomach The overlying muscle is closed The Ewalt tube is removed and the wound closed Tube feeding is not required The procedure is aseptic and requires short postoperative hospitalization

Peickoff[1] reports a case of pharyngeal diverticulum in a man who first noticed, five years before, that on swallowing solid foods, something stuck in his throat and caused him to choke and regurgitate undigested food Similar episodes recurred on unpredictable occasions Symptoms became more aggravated and soon a peculiar noisy click followed by a gurgle on swallowing developed So annoying was this to the family that eventually the patient refused to have meals with his family or strangers, however, he considered the pouch to have one advantage he noted that at cocktail parties the first few swallows of liquor lodged in the pouch which had become quite large Later in the evening he noted that he could have an extra drink when he needed it by pressing the pouch with his thumb A description of the usual technique for diverticulectomy is included

Hudson[14] states that few surgeons have the opportunity of studying pharyngeal diverticula because of its rarity All observers, however, are agreed that as the pharyngeal pouch increases in size it tends to obstruct the esophagus by direct pressure when distended with food this increases the symptoms and causes anxiety and discomfort to the patient with loss of weight Hudson reports nine cases of pharyngeal diverticulum in which the patients complained of discomfort on swallowing, choking sensations, regurgitation and unpleasant taste in the mouth, together with loss of weight depending upon severity of symptoms Hudson considers nocturnal dysphagia with cough of great diagnostic importance All nine patients were treated by the one-stage operation, the technique of which is described in detail Hudson believes that the transverse fibres of the cricopharyngeus muscle situated caudal to the pharyngeal pouch is responsible for the formation of the diverticula, and this muscle is divided at the time of operation He warns against exerting too much traction on the pouch for fear of amputating too much pharyngeal or esophageal mucosa Good results were obtained in all except two patients who had to have a second operation because of early recurrence thought to be due to persistence of the transverse fibres of the cricopharyngeus Hudson, therefore, believes that deliberate division of these fibres will tend to produce better results

INSTRUMENTS

Somers[19] describes how a pencil-sized pocket flashlight can be converted into an electrical handle for the standard nasopharyngoscope and points out that the amount of current is just right

Inspection of the nasopharynx before, during and following adenoidectomy is essential for performance of adequate adenoidectomy, since the form of the nasopharyngeal space varies widely in different individuals Toward this end, Neivert and Kallen[20] present a simple palate retractor which doubles as a tongue protractor and greatly facilitates direct inspection of the nasopharynx It consists of a flat piece of metal seven inches long and five-eighths inch wide with one sharply angulated end The remainder of the strip is gently curved

IRRADIATION

For many years hyperplasia of lymphoid tissue in the nasopharynx has been treated by irradiation In a most informative manner, Garland and associates[21] discuss the relative merits of Roentgen and radium therapy for benign conditions In an attempt to determine which of these two methods is the most effective and what the actual results of treatment in practice are, they reviewed several hundred cases They present an excellent discussion of pathologic considerations in which the mechanisms of aero-otitis and secretory otitis are described The treatment of choice in hyperplasia of the lymphoid tissue is radiation therapy and the radium applicator is easily applied to the nasopharynx with the aid of local anesthesia Beta Roentgens extend only about 1 cm and are thusly absorbed

Garland and associates believe that the simplest and safest method of irradiation of lymphoid tissue in the nasopharynx is external administration of Roentgen rays The only disadvantage of this type of therapy is that six treatments are necessary instead of the usual three with radium. Anesthetization is not required, and children readily submit as soon as they learn that the initial treatment is painless The great advantage of Roentgen therapy is that the whole lymphoid bearing area of the nasopharynx is included in each treatment. Usually six treatments are given at weekly intervals The technique is described Garland and associates review the results of radium treatment reported in the literature and present their results of Roentgen therapy in 720 cases of lymphoid hyperplasia Fifty-five per cent of adults with deafness secondary to hyperplastic lymphoid tissue were cured with a single course of treatment and 60 to 90 per cent were relieved of presenting signs or symptoms

If Roentgen therapy is as good as proclaimed by these authors, radium therapy would be quickly discarded and all patients with lymphoid hyperplasia together with their complications would be quickly cured This is a most excellent and rather convincing article however, the impression is obtained that the authors are somewhat prejudiced

Hardy and Bordley[22] give a report on a screening program in the public school system of Baltimore in which the use of the nasopharyngeal radium applicator in cases of lymphoid hyperplasia of the nasopharynx in children was tested This report consists entirely of testing methods used, methods of analysis of results, and the like and does not give any clinical data or results.

Ballantyne[23] studied 48 cases of deafness due to Eustachian tube obstruction encountered over a period of 18 months In 37 cases one tube was irradiated in the usual manner and the other ear maintained as a control Eleven patients had no treatment Audiograms were obtained one month three months and six months later The results were contrary to what one would expect In the 37 cases in which one ear was treated, improvement occurred as often in the untreated as in the treated ear. Improvement was noted in 60 per cent of the treated cases and in 82 per cent of the untreated cases.

Weisman[24] attributes the occasional failure of tonsillectomy and adenoidectomy to produce the desired results of well-being to the fact that even after an expertly performed operation, remnants of infected and hypertrophied lymphoid tissue remain. He describes Waldeyer's ring and adds that frequently lymphoid tissue is seen as discrete follicles on the posterior pharyngeal wall. The nasopharyngeal Beta radium applicator has been used in the treatment of some of these cases. The small localized area affected by the radium applicator limits its usefulness in many cases. Because of the ease of application, Weisman prefers Roentgen therapy directed to the nasopharyngeal region, and since lymphoid tissue is extremely radiosensitive, this tissue melts away long before any noticeable effects are produced on any of the neighboring structures.

SURGERY

Reeves[25] points out that hypertrophic salpingopalatine folds, or lateral pharyngeal bands, may cause nasal obstruction even after an adequate adenoidectomy. Two cases are presented in which relief was obtained by removal of these folds with an adenoid punch.

Conway[26] gives a brief historical review of procedures used to try to attain normal speech in cases of cleft palate. He reports his experience in the handling of 38 complicated cases, in all of which at least four previous operations had been performed. He considers the use of a combined "push back" procedure and an inferiorly attached pharyngeal flap to be the most successful technique. In this procedure the pharyngeal flap is permanently fixed to the soft palate.

Hitschler[27] presents a case of a broken needle in the tonsillar fossa. Attempts to recover the needle at the time of the operation and some time later by biplane fluoroscopy were unsuccessful Four years later no symptoms had developed Methods of prevention of such an accident, means of recovery of needles and possible complications are discussed

Since good results have been reported with a dilute solution of procaine given intravenously for a variety of traumatic and painful conditions, Somers[28] decided to test its efficacy in the relief of post-tonsillectomy pain Procaine in 1 per cent and 2 per cent concentrations was administered in different amounts to 41 tonsillectomized soldiers The morning following operation, although some analgesia was obtained and there were no severe reactions or deaths the toxic effects were severe enough to preclude this type of analgesia in post tonsillectomized patients

Pearlman and Loewy[29] analyzed 45 cases of secondary hemorrhage from the tonsils and adenoids in 1,035 cases of tonsillectomy and adenoidectomy as to the barometric pressure changes at the time of hemorrhage No correlation was established, but on the basis of their observations they state that "it is conceivable that the time of occurrence may be altered by prevailing conditions of these factors"

The nasopharynx is one of the most inaccessible areas of the body for diagnosis and treatment. Various surgical approaches to this area have been suggested, but most of them have been unsatisfactory Wilson[30] describes a new surgical approach which has proved satisfactory in his hands. A transverse incision is made in the palate just anterior to the posterior margin of the hard palate and is extended downward at either end along the pterygomandibular raphe. The posterior spine of the hard palate is fractured the tensor palatinus tendons are cut, and the whole soft palate is retracted posteriorly to expose to view the nasopharyngeal and posterior choanae With this approach any surgical procedure desired can be performed in this area The incision is readily sutured and there is no postoperative disability

Sheridan[31] points out the difficulties of doing a complete adenoidectomy He advocates the use of a bent metal suction tip as a palate retractor and a 2 cm. laryngeal mirror to provide a better view of the nasopharynx, both before, during and after adenoidectomy.

BENIGN TUMORS

Kerwin[32] reports a case of juvenile nasopharyngeal angiofibroma in a boy 16 years of age which was successfully treated with Roentgen-ray and androgen therapy. This is a rare type of tumor occurring in adolescent boys, which regresses as maturity is reached. The tumor is a benign fibroma, but because of its inaccessible position and sometimes rapid growth, it may be locally destructive. The main symptoms are hemorrhage and nasal obstruction. Because of the danger of serious hemorrhage, biopsy is not always advisable. Since spontaneous regression can be expected with maturity, the most conservative therapy should be employed. Kerwin considers radiation and hormone therapy as the best methods of control. Large tumors may be resected by electrocoagulation and recurrences may be controlled by interstitial irradiation and androgen therapy.

From a histopathologic aspect, nasopharyngeal fibromas are considered as benign tumors, but from an invasive point of view, Paredero del Bosque and Sebastian[33] are of the opinion that they behave as malignant growths. From a review of the literature they concluded that nasopharyngeal fibromas are extremely rare in England, not too uncommon in America and common in Egypt. These fibromas usually occur in males between 10 to 25 years of age. They commonly show spontaneous regression with oncoming maturity. The various methods of treatment are reviewed, and the conclusion is drawn that implantation of radium and repeated electrocoagulation yield the best results. Nasopharyngeal fibromas are radioresistant. Because of extensive and dangerous hemorrhage, surgical excision is seldom if ever used. Four cases encountered in the last three years are reported. This is a splendid article and valuable because of the review and compilation of opinions of outstanding men in this field.

Jepson[34] presents an unusual case of a persistent chordoma of the nasopharynx in which treatment over a long period of time, both by Roentgen-ray and irradiation and by surgical removal, resulted only in temporary benefit. Chordomas are tumors arising from embryonic remnants of the notochord They occur at either end of the notochord and rarely are found in the nasopharynx.

Hoogland[35] reports an extremely rare case of nasopharyngeal cyst of branchiogenic origin in a man 69 years old who complained of pain and deafness in the right ear for six weeks Examination disclosed a soft, fluctuating cyst-like tumor the size of a chestnut in the right side of the nasopharynx pressing upon and obliterating a view of the Eustachian orifice Aspiration of this fluctuating mass yielded 10 cc. of brownish opaque fluid Ten months later the patient still had no complaints and re-examination yielded negative results A diagnosis of nasopharyngeal cyst originating from the first branchial pouch was made It was later determined that 45 years before the patient had a mass below the right auricle, which was considered at that time to be inflammation of the first external branchial cleft. This abscess subsided after incision and drainage Guissani reported a similar case in 1928

Hlavacek[36] reports an unsual case of a woman, aged 45 years, in whom a large hypopharyngeal polyp developed in the mouth after an attempt at strangulation She had had no previous difficulty in swallowing, but the growth caused suffocation which was relieved by its removal The polyp was 21 cm long with a peripheral circumference of 7 cm It was club-shaped and attached posteriorly to the cricoid cartilage Histologic examination revealed mature lipomatous tissue

Penha[37] reports a case of nasopharyngeal fibroma in a hemophiliac patient with repeated hemorrhages which failed to respond to routine general and local treatment. He recalled that the natives of Portugal used the nettle urtica membranacea to stop bleeding, either by infusion or local application of the baked leaves therefore when all other measures failed

Penha employed this common plant which promptly controlled the hemorrhage This same hemostatic agent has been used successfully in other cases Penha is conducting extensive investigation to determine the full therapeutic value of this plant, not only in cancer but also in leucemia

Finerman[38] presents the case of a girl 13 years of age who complained of nasal obstruction of two years' duration, which was caused by a growth in the nasopharynx, proved by biopsy to be a juvenile nasopharyngeal fibroma Considerable reduction in the size of the tumor was noticed six weeks following administration of 1,650 r of Roentgen-ray Six months later the possibility of radon implantation was being considered, as surgical excision was being delayed as long as possible This case is of interest not only because of the rarity of nasopharyngeal angiofibromas but also because some authors have challenged the occurrence of this type of growth in females

MALIGNANT TUMORS

In spite of our increased knowledge of nasopharyngeal carcinoma, Hickey[39] believes that the condition is too frequently overlooked For this reason he presents a brief review of pertinent literature to indicate the trend of changing concepts of the disease and a summary of data from a survey of 25 cases in tabular form The fact that only three have survived more than five years indicates that despite refinements in diagnosis and treatment "one frequently finds oneself baffled and somewhat helpless in achieving more than palliative control of the primary lesions and their metastases"

In an excellent and comprehensive article concerning Roentgen therapy of carcinoma of the hypopharynx, Jacobsson[40] presents an analysis of 322 cases treated beween 1939-1947, 75 per cent of which were in the lower part of the hypopharynx or below the level of the superior border of the cricoid cartilage Sixty per cent of the series were females, in 90 per cent of whom the Plummer-Vinson syndrome was present Treatment consists of 5,700 to 6,000 r over a period of 28 to 30 days This is given through four ports and is guided by beam direction through fluoroscopy An overall five-year cure rate of 14 per cent was obtained The five-year cure rate for lesions in the lower hypopharynx was 17 per cent. These results are much better than those obtained in other series

Rojas[41] reports a case of lymphoepithelioma of the nasopharynx, which was first manifested by glandular enlargement on the right side of the neck Further examination revealed a mass occupying the greater part of the nasopharynx and biopsy established the diagnosis Roentgen therapy was immediately instituted After 6,200 r were given in 29 days, the tumor and the cervical enlargement disappeared Two years later adenopathy developed on the left side of the neck. Cortisone was given for 19 days, after which acute anemia developed, necessitating transfusions More Roentgen therapy was given and all symptoms disappeared

Whereas this is an interesting report, it is probably premature as far as cure is concerned, moreover, the value of cortisone must be questioned as in all probability the good results were accomplished by Roentgen therapy

Epstein[42] advocates laminography in the diagnosis of nasopharyngeal tumors, and he points out that their clinical diagnosis is usually delayed until the appearance of symptoms referable to the eyes, ears or upper nasal passages such as diplopia nasal discharge, nasal blockage headaches poor hearing and palpable lymph nodes These types of tumors usually originate in the soft tissues of the nasopharynx and radiologic identification of alterations in these soft tissues is only occasionally mentioned as an important diagnostic sign Epstein reports 10 cases, the youngest being a boy of 14 years with a nasopharyngeal fibroma and the oldest a woman 67 years old with a large lymphoepithelioma Laminography is ideal for radiologic investigation of the nasopharynx The technique is well described, and the reported cases demonstrate the existing pathologic alterations.

In an excellent thesis for the American Laryngological, Rhinological and Otological Society, Inc., Miller[43] presents the results of a statistical analysis of 102 cases of nasopharyngeal cancer encountered at several hospitals. Although his results compare favorably with those of other reported series, this paper is an excellent discussion of this subject and should be read in the original form by neurologists, ophthalmologists and general practitioners as well as otolaryngologists. Familiarity with the signs and symptoms might help to reduce the great time lag between onset of symptoms and diagnosis of nasopharyngeal cancer.

In addition to a rather complete historical review, a discussion of the histopathology, incidence, pathogenesis and symptomatology of the disease is included. The diagnosis can almost always be made by mirror nasopharyngoscopy with the use of the electric nasopharyngoscope. The commonest chief complaints are nasal obstruction, cervical adenopathy and unilateral deafness. Cervical metastases are present at the time of diagnosis in from 40 to 77 per cent of cases. Treatment is confined to the use of Roentgen-ray or radium, or both, and results are poor; however, the five-year cure rate has increased tremendously in the past 15 years, some authors reporting as high as a 25 per cent five-year cure rate.

Schoolman[44] urges careful routine examination of the nasopharynx in order to make an early diagnosis in cases of malignancy of the nasopharynx. Close cooperation between otolaryngologist and radiologist is essential in the treatment of these cases. Prognosis is better in the more radiosensitive tumors.

Stock[45] reports the results of a study of the effects of nitrogen mustard and urethane on nasopharyngeal cancer. Twenty-five patients with late stages of carcinoma of the pharynx were treated with 0.1 mg. of nitrogen mustard per kilogram of body weight daily for six doses. In a few cases there was extreme diminution in the size of the gland, and in advanced cases with bony involvement temporary decrease in pain, however, in no case did this temporary remission last longer than four weeks In most cases symptoms were not alleviated and the size of the tumor was not affected

Twenty three patients with hopeless nasopharyngeal cancer were treated with urethane. After an intravenous drip trans fusion of 5 per cent glucose in water had been running for a few minutes, 10 gr of urethane dissolved in 20 ml of water were injected into the tube The urethane was then washed through the vein quickly and the drip continued until 1 000 ml of 5 per cent glucose had been given The immediate results in these cases were as follows five showed great im provement, four slight improvement, four no improvement five refused adequate treatment and five died, however, Stock stated, 'So far as can be seen at present, the effect is only temporary, for in most cases where some benefit has been shown, the tumor has recurred fairly rapidly '

Hynes[16] reminds us that extensive cancer involving both larynx and pharynx presents a difficult therapeutic problem for which there is as yet no satisfactory solution Usually such patients are treated by radiation Of 21 patients thus treated prior to 1945, only one survived Twenty of these cases were candidates for extensive radical excision Three patients not included in the radiation series had unilateral neck dissection and pharyngolaryngectomy, two of whom left the hospital in good condition and the third was convalescing at the time of the report The surgical technique, which is described in detail, represents a formidable procedure, but unless such methods are adopted these patients are doomed The salvage is such that the procedure is warranted and it is hoped that more laryngologists will follow Hynes' practice

Martin and Quan[17] present statistical evidence of the racial susceptibility of the Chinese for nasopharyngeal cancer They suggest as an explanation for this a racial or hereditary tendency rather than an environmental one as suggested by some From a survey of the literature and analysis of clinical and statistical data from the Memorial Hospital they believe there is suggestive evidence that this susceptibility may be shared by all Orientals except the Japanese

A rare and interesting case of spontaneous pneumocephalus in a patient with extensive carcinoma of the nasopharynx is reported by Raider[48] The collection of air was apparently both cortical and ventricular, having entered the brain through a defect in the base of the skull caused by the malignant growth The patient recovered from the pnenumocephalus without untoward effect, but, of course, the carcinoma was not cured, although the patient was alive and showed little change 14 months later

Seltzer[49] gives a brief discussion of the various types of neoplasms of the nasopharynx These include nasopharyngeal fibroma, squamous cell tumor, lymphoepithelioma and lymphosarcoma The most suitable treatment for these lesions is irradiation

In an interesting and comprehensive article, Digby[50] calls attention again to the fact that the pattern of nasopharyngeal carcinoma varies in different parts of the world He thinks this is due to the differences in climate, environment, innate hereditary characteristics, customs and habits of the inhabitants He cites the prevalence of nasopharyngeal carcinoma in Hong Kong, where it is the second commonest variety of malignant disease In England and North America, nasopharyngeal carcinoma forms only a small fraction of 1 per cent of all cases of malignant disease, whereas in Hong Kong it constitutes 18 per cent of all malignant cases Many theories have been advanced to explain this high percentage of nasopharyngeal malignancies in the Chinese, but none has been definitely proved In addition to an excellent discussion of the pathology, Digby describes his method of establishing a clinical diagnosis, which is certainly unique As in any type of carcinoma, the first principle of treatment is that early diagnosis is essential The presence of any one sign referable to nasopharyngeal disease demands a thorough investigation of the nasopharynx Radiotherapy is the best method of attacking these malignancies, since the cells are extremely radiosensitive and usually quick response is obtained If the case is diagnosed early and treatment instituted immediately, good results may be expected Unfortunately, too few cases are seen early, consequently poor results are obtained in a high percentage of cases Digby has presented his views and wide experience of years in Hong Kong in an interesting style. In view of the large number of cases he has seen his opinions must be accepted as authoritative

Thompson[31] reports four cases of lymphoepithelioma of the nasopharynx and discusses the symptomatology, diagnosis and treatment of this condition A rather extensive discussion of the microscopic diagnosis of nasopharyngeal tumors is given. It becomes apparent from the divergent opinions quoted that the differential diagnosis of the various types of malignancy of the nasopharynx is extremely difficult This is especially true in differentiating between lymphoepithelioma and transitional cell carcinoma, many pathologists consider them to be the same condition. This article should be read in its original form by those interested in this type of tumor

Malignant neoplasms of the nasopharynx are largely epithelial in origin Squamous cell carcinomas are the commonest, then adenocarcinomas and lymphoepitheliomas Tumors of other origin consist of sarcomas plasmocytomas and lymphocytomas Extremely rare tumors in this area include chordomas, rhabdomyosarcomas and salivary gland tumors In a clear, concise and well organized article, Omerod[32] discusses the signs and symptoms of these tumors, which he conveniently divides into four groups nasopharyngeal, otologic, ophthalmoneurologic and cervical metastatic A number of neurologic syndromes are described and typical case histories are presented

Because of the rarity of radiation cancer in the deep tissue following external radiation, Goolden[33] reports four cases of patients in whom malignant tumors of the laryngopharynx developed following irradiation of the neck for benign conditions In each case 25 years elapsed between the radiation therapy and the diagnosis of radiation cancer A long latent period is characteristic of radiation cancer In most cases of radiation cancer gross changes in the overlying skin are present

Heck and McNaught[34] report two cases of juvenile fibroma which were successfully removed through a transpalatal approach They point out that the advantage of such an approach is that postoperatively the structure is essentially normal as contrasted with the permanent disruption of nasal structures following the transantral approach

Gynning[35] has treated five patients with carcinoma of the hypopharynx by the rotation Roentgen therapy method which is commonly used in carcinoma of the midesophagus Two of these are free of symptoms over seven years after treatment These two cases are reported and the technique, dosage and measurements of the method are discussed

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ELECTROCOAGULATION OF THE VESTIBULE IN GUINEA PIGS *†

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Vertigo, tinnitus and deafness are the most prominent symptoms of the condition known as 'hydrops of the labyrinth" Conservative medical treatment may be directed toward improving the basic pathological condition or when medical treatment is ineffective, the function of the affected ear may be eliminated by radical surgical treatment This radical surgery is justified by clinical observations and experiments Vertigo, one of the most disturbing symptoms is due to an imbalance in the activity of the two labyrinths If the activity of the abnormal ear is eliminated, the vertigo improves rapidly and ultimately a stable compensation is reached The experimental work of Bechterew[1] proved that the compensation occurs in the vestibular nuclei When tinnitus is a serious symptom total destruction of the affected cochlea is required

Several surgical techniques have been devised to eliminate the abnormal activity that is the basis of the vertigo and tinnitus. The commonest procedures are *1* sectioning the VIIIth nerve as in Dandy's[2] operation *2* electrocoagulation of the vestibule as in Day's[3] operation, *3* removal of the membranous labyrinth as carried out by Cawthorne,[4] and *4* alcoholic injection into the vestibule.[5]

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All of the procedures are usually successful in relieving both the vertigo and tinnitus, but following section of the VIIIth nerve, tinnitus may remain or else reappear several weeks after the operation Sometimes after the other procedures the tinnitus may remain or the vertigo may be induced by particular movements of the head This persisting vertigo is usually attributed to some sensory structure which has escaped destruction by the operation

The original purpose of the present study was to standardize the procedure of electrocoagulation of the vestibule in such a way as to minimize the loss of hearing Subsequently we realized that there is probably no advantage in preserving hearing in hydrops of the labyrinth because the disease has already caused such great hearing loss *and in addition* there is likely to be severe tinnitus unless all hearing is abolished We undertook, nevertheless, to standardize the electrocoagulation in order to minimize the risk of unintentional injury of the facial nerve and, furthermore, we hoped through histological and pathological stdures to find the basis for the occasional persistence of vertigo and tinnitus following electrocoagulation of the vestibule

METHOD

Experimental Animals

The experiments were performed on 57 adult guinea pigs These animals were chosen because of their suitability for relatively rapid preparation for histological study and because our electrocoagulation methods had been standardized for guinea pigs

Apparatus

A Cameron Duo-Cauterodyne* provided with a special electronic switch for regulating the duration of current flow was used for the electrocoagulation This cautery is a radiofrequency power generator operating at four megacycles The electronic switch consists of a gas tube (No 2051) with a

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*This instrument was generously loaned by the Cameron Surgical Specialty Co

RC timing circuit in its grid circuit and a relay in its plate circuit for turning on the B voltage supply of the Cameron Duo-Cauterodyne The filament current was kept on continuously to avoid the delay of about two seconds required to warm up the filament when the power is turned on by the foot switch supplied with the instrument

Two types of sounds were used for stimulation For pure tones a General Radio Oscillator Type No 1304-A was connected to an attenuator and the output was fed to a Langevin 101 C Power Amplifier, which was connected to a Permoflux PDR 10 Earphone. This earphone was connected by an aluminum coupler and a small length of plastic tubing about 3 or 4 mm. in diameter to a small speculum which was sewed into the guinea pig's external canal, forming a closed acoustic system.

The other system utilized all the equipment except the pure-tone oscillator Instead of this, it employed a square-wave generator which feeds two sets of band-pass filters set to the appropriate frequency Each set of filters has a nominal cut-off of 18 db per octave The resulting wave form is a brief train of waves which rises to a maximum in three or four cycles and then falls back to a minimum value in three to 10 waves (depending upon the frequency) The repetition rate used for these 'tone pips' was usually 20 pips per second

Surgical Procedure

The external semicircular canal was approached through a retroauricular incision. The facial nerve was exposed where it emerges from the Fallopian canal Under a dissecting microscope the bulla was opened immediately above the nerve An opening of about 5mm. in diameter gives a full view of the ampullae of the external and the superior semicircular canals. The external canal is easily identified by its close relation with the middle ear cavity and the facial nerve.

The otic capsule of the ampulla of the external semicircular canal was fenestrated (In some cases the fenestra was made in the middle third of the external semicircular canal instead of at the ampulla. In these third was through a hole entering the bulla between the facial nerve and the styloid process) The membranous labyrinth was then treated by one or another of the following procedures for surgical injury

a *Surgical injury* A fine needle was introduced into the vestibule and swept from side to side in several directions in an effort to destroy all of the sensory structures In a few cases the injury was deliberately confined to cutting the membranous labyrinth just at its junction with the crista and without damage to any sensory structures

b *Labyrinthectomy* The membranous labyrinth was removed from the vestibule by means of a dental broach

c *Electrocoagulation* The needle electrode was introduced into the labyrinth (The shank of the needle was not insulated in any way) In most cases the time of current flow was 0 5 second, but sometimes it was reduced to 0 2 or increased to 1 0 seconds

The intensity of the current was always between 20 and 45 milliamperes

In acute experiments cochlear potentials, both the cochlear microphonics and the action potentials, were observed before and after the surgical injury to the vestibule The electroacoustic methods have been described elsewhere[6] In chronic experiments the cochlear potentials were not observed at the time of operation, but only when the animal was sacrificed

In the chronic experiments the operation was performed under aseptic conditions, and the animals were treated with penicillin for four days after surgery In this group ether anesthesia was employed for the operation, but in all cases dial in urethane was used for anesthesia in the final tests

Following the electrical studies the animals were perfused and fixed The temporal bones were embedded in celloidin Serial sections were cut and then stained with hematoxylin and eosin

RESULTS "ACUTE" EXPERIMENTS.

Twenty six ears (20 animals) constitute the "acute" group in which the animals were sacrificed between a few minutes and 24 hours after the surgical injury of the labyrinth The results of the various types of injury were as follows

1 *Surgical Injury*

Only two ears were injured with the needle without electrocoagulation In one the membranous vestibule was destroyed, in the other the membranous labyrinth was cut close to the crista. Microscopic examination of the first ear showed that the crista of the external semicircular canal had been detached and the macula of the utricle was partially injured No damage had been done to the saccule or to the crista of the superior or the posterior semicircular canal (see Fig 1) The cochlea appeared entirely normal on histological examination. The cochlear potentials were recorded in this experiment before and after the fenestration Tests were made only at the frequencies 500, 2,000 and 8,000 cycles per second The greatest effect was produced at 500 c.p s where the threshold for both action potentials and cochlear microphonics was elevated by 10 and 16 db, respectively At 2,000 and 8,000 c p s no change of as much as 15 db was produced The "electrical audiograms" are shown in Fig 2

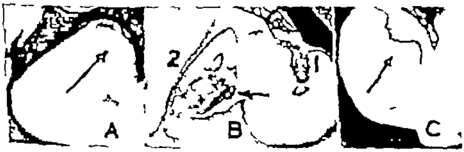

Fig. 1. Injury by needle alone. Survival three hours. (A) Vestibule showing hemorrhage and some pieces of bone Arrow points to the region from which the crista of the external semicircular canal had been totally detached. (B) Vestibule. (1) Normal crista of superior semicircular canal and normal macula of the utricle. Other sections show some injury of the utricle Arrow crista of the external semicircular canal projecting into the utricle. (C) Vestibule. Arrow points to the normal crista of the posterior semicircular canal

Microscopic examination of the second ear in which the external semicircular canal had been cut showed *no damage* of the sensory structures either in the vestibule or in the cochlea The electrical responses of the cochlea showed a mild loss of sensitivity at 500 c p s, very much like that in the previous ear

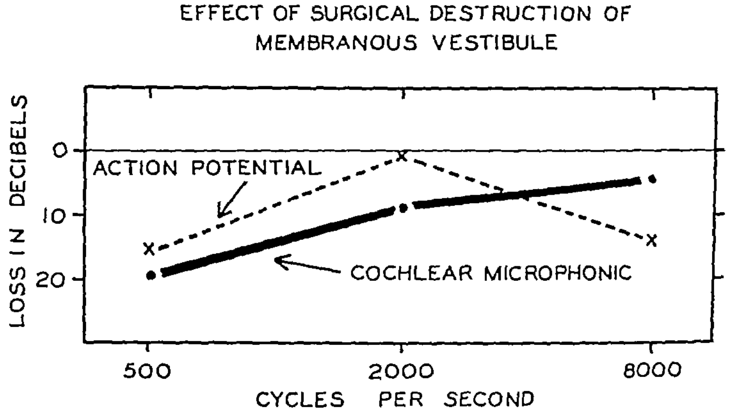

Fig 2 The thresholds were determined before and immediately after surgical injury to the membranous vestibule.

2 *Labyrinthectomy*

Four ears (three animals) were treated with this procedure Microscopic examination confirmed the total removal of the walls and the crista of the external semicircular canal and of the walls and most of the macula of the utricle In most cases the utricle was severely injured The walls and crista of the superior semicircular canal were damaged or partially removed, but as a rule the crista of the posterior semicircular canal and the macula of the saccule were uninjured The sensory structures of the cochlea were normal

The effect of such labyrinthectomy upon the cochlear microphonic and on action potentials was a mild loss of sensitivity (30 to 35 db) at 500 c p s and little or no effect at 2,000 and at 8,000 c p s

3 *Electrocoagulation*

A total of 20 ears (15 animals) were treated with electrocoagulation In general this procedure caused necrosis of the crista of the external semicircular canal and the utricle

Sometimes the crista of the superior semicircular canal was also involved. The extent of the necrosis depended upon the strength of the current. The injury produced by 20 milliamperes (for half a second) was mild, but 40 or 45 milliamperes caused severe injury. The mild damage was no greater than what can be produced by surgical injury without the help of the electric current. With the stronger current, however, the injury was definitely greater and presumably was caused by the current (see Figs. 3 and 4). Even with the stronger current, however, the crista of the posterior semicircular canal and the macula of the saccule usually escaped injury.

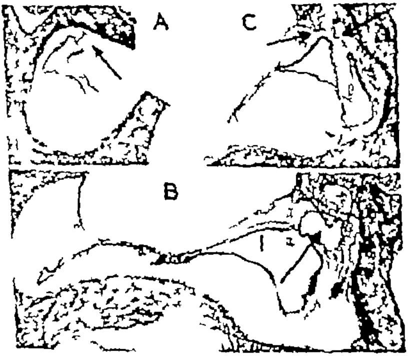

Fig. 3. Electrocoagulation by 40 milliamperes for 0.5 second. Survival 0.3 hour. (A) Fenestra in external semicircular canal close to the crista. The latter is nearly detached and has been cauterized. Arrow points to the path of the electrode. (B, 1) Normal macula of the utricle. Arrow: hole made by the electrode. The macula has been partially detached and all of the tissue around the hole shows severe necrosis. (C) The arrows indicate the end of the pathway of the electrode. The macula of the utricle and the crista of the *superior* semicircular canal have been detached from the bony walls. Necrotic tissue surrounds the pathway.

The cochleas of this group of animals showed mild necrosis of some of the hair cells of the organ of Corti. The injury was most pronounced among the outer hair cells of the first and second turns. The stronger the current the greater was the extent and severity of the injury. In the experiments in which the animal was sacrificed and fixed within the first 24 hours no structures in the cochlea other than the hair cells showed any signs of injury

The cochlear microphonics and the action potentials after the operation usually showed a loss of sensitivity of 20 to 30 db at 500 c p s when the coagulating current was 20 to 35 milliamperes This current produced no significant effect on the thresholds for 2,000 and 8,000 c p s

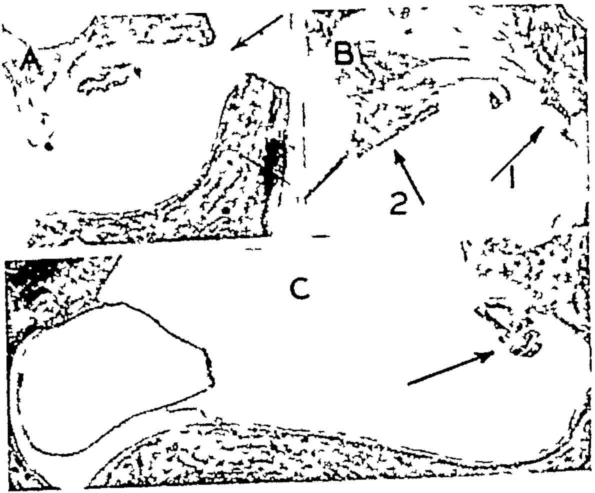

Fig 4 Electrocoagulation by 45 milliamperes for 1 0 second. Survival 1 5 hour (A) Arrow points to fenestra in the external semicircular canal The membranous canal has been reduced to a small necrotic mass (B) Arrow 1 shows where the crista of the superior semicircular canal has been destroyed Arrow 2 points to the partially destroyed and totally necrotic macula. (C) Arrow shows the totally necrotic crista of the exernal semicircular canal

When coagulating currents of 40 to 45 milliamperes were used the loss of sensitivity for the electrical responses was slightly greater Sometimes the responses at 2,000 c p s were unaffected, but in other cases losses as great as 40 or 50 db were found both for the microphonics and for the action potentials The responses at 8,000 c p s were often practically normal In other experiments, however, the threshold was raised by as much as 40 db for the microphonic and 80 db for the action potentials Fig 5 shows a case of such severe injury

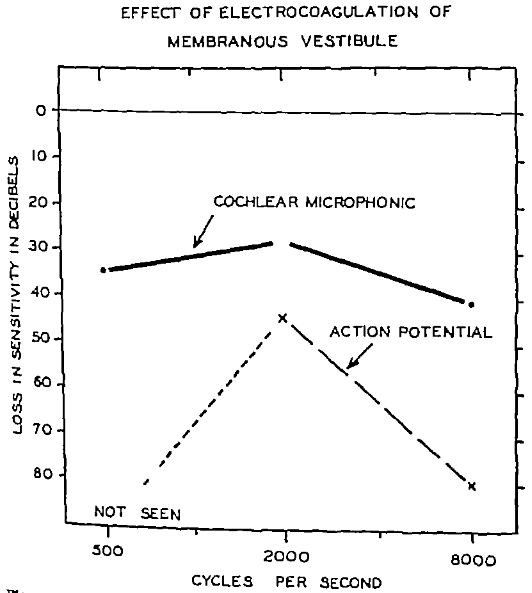

Fig. The "thresholds" were determined before and again immediately after fenestration, followed by electrocoagulation of the vestibule with 45 milliamperes for 0.5 second

RESULTS CHRONIC EXPERIMENTS

Twelve animals (15 experimental ears) were kept alive for periods from one to seven weeks after the operation Considerable difficulty was encountered keeping these animals alive for the desired length of time Twenty-five others died between the fourth and the eighth day after the operation but the ears were not examined histologically because of the probability of autolytic artifacts A few of the 25 animals died from pneumonia, otitis media, or meningitis In others, the most probable cause of death seemed to be inanition, as the animals refused to eat and took very little water

1 *Surgical Injury*

Surgical injury was used in five of the animals in this group with a total of six ears In three of these ears the fenestra was made in the ampulla of the external semicircular canal, in the other three it was made about the middle third of the canal One of the ears fenestrated in the ampulla developed a suppurative otitis media and labyrinthitis In this case *all* of the sensory structures of the cochlea and the vestibule were destroyed by the infection The fenestra was closed by a mild fibroblastic and vascular proliferation coming from the periosteal layer The fibrous tissue showed a pronounced infiltration by leucocytes

In the second ear fenestrated in the ampulla the membranous canal was cut just at its junction with the crista but the vestibule was not injured The animal was sacrificed eight days after the operation Microscopic examination showed that all of the sensory structures of the vestibule and cochlea were normal The fenestra (see Fig 6) was closed by fibroblastic and vascular proliferation that had originated in the

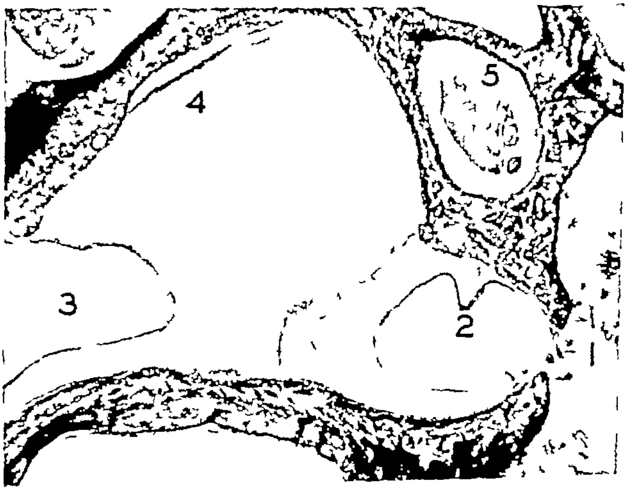

Fig 6 Surgical section of the membranous canal close to the crista. Survival eight days. (1) Fibroblastic and vascular proliferation blocking the fenestra (2) Ampulla of the external semicircular canal with normal crista. (3) Normal crus communis (4) Normal saccule (the collapse of the walls is an artifact) (5) Facial nerve

periosteal and endosteal layers The enchondral layer apparently does not take an active part in the process of repair Numerous bits of bone were found near the fenestra with signs of reabsorption and fibroblastic proliferation Apparently the proliferation around some of the pieces of bone is due to the presence of either periosteal or endosteal tissue Where the fibrous tissue is dense there are some signs of calcification The healing process inside the ampulla presents superimposed and concentric layers of fibrous tissue which extend further along the canal than across the ampulla The cochlear responses, both microphonics and action potentials, for this ear were within normal limits

In the third ear that was fenestrated at the ampulla the vestibule was injured The animal was sacrificed eight days after the operation Microscopic examination later showed both an otitis media and the usual surgical damage to the crista of the external semicircular canal and the macula of the utricle, but the cristas of the superior and posterior canals and the saccule were not affected The healing process at the fenestra was similar to that described in the previous case All of the sensory structures of the cochlea were normal, and there was no sign of infection of the inner ear, nevertheless, the thresholds for both the cochlear microphonics and for the action potentials were elevated by about 55 db The probable explanation of this hearing loss is the otitis media that filled the cavity of the inner ear

In three ears fenestrated in the middle third of the external semicircular canal the membranous canal was destroyed with a fine needle that was introduced in the direction of the ampulla. The animals were sacrificed between three and four weeks after the operation Microscopic examination showed that all of the sensory structures of the cochlea and the vestibule remained normal The fenestra was blocked by fibrous and vascular tissue which filled the canal for a distance of about 1 mm (see Fig 7) The fibrous tissue extended just to the opening of the ampulla Numerous bits of bone were present at the fenestra and in the canal They showed signs of resorption and fibroblastic proliferation, and calcification or formation of new bone could be seen in the dense fibrous tissue at the surface of the canal

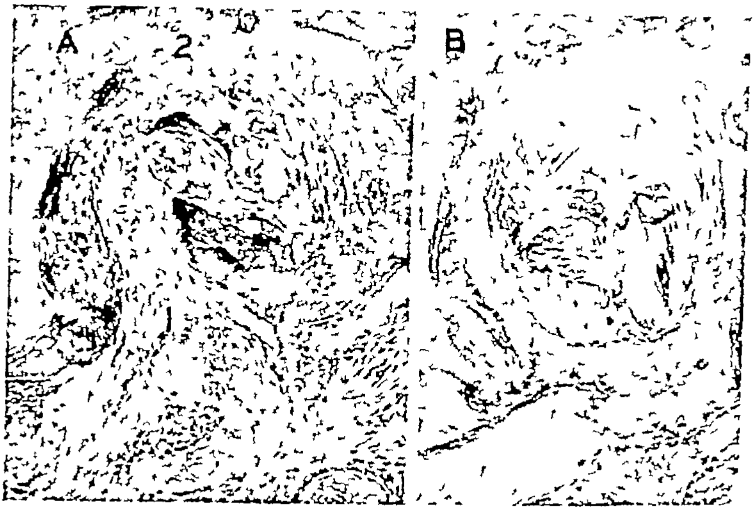

Fig 7 Surgical injury by needle passed along the external semicircular canal toward the ampulla from a fenestra in the middle third of the canal Survival 20 days (A 1) Fenestra filled with fibrous tissue formed from the periosteum. The lumen of the canal is also completely filled with fibrous tissue pieces of bone and new bone (2) Proliferation from the endosteum (B) Same canal about 0 75 mm from (A) The canal is still filled by fibrous tissue and new bone but the tissue is not so dense nor is the formation of new bone so active

2 *Labyrinthectomy*

No animals survived this procedure long enough to be included in the chronic group

3 *Electrocoagulation*

Seven animals (nine operated ears) constitute this group In seven ears the fenestration was in the middle third of the external semicircular canal, in the other two the vestibule was coagulated through a fenestra in the ampulla In all cases the current was 35 milliamperes

The first animals were sacrifiecd at one, four and seven weeks after the operation The three ears taken after one week's recovery showed no damage to the sensory structures of the inner ear and the healing process at the fenestra followed the same pattern as already described The electrical responses were not studied in these animals The only ear taken at four weeks showed normal sensory structures in the vestibule and the usual fibroblastic proliferation and formation of new bone at the fenestra and in the semicircular canal In this ear there was mild atrophy of the organ of Corti and Reissner's membrane was collapsed The thresholds for both microphonics and action potentials were elevated about 20 to 25 db at 500 2,000 and 8,000 c.p s One ear taken after seven weeks' recovery gave no electrical responses Histological examination showed complete absence of hair cells throughout the organ of Corti The supporting cells were normal in the apical turn but showed some atrophy in the first and third turns In the second turn the organ of Corti was replaced by flat epithelium The ganglion cells and the mesothelial cells were uninjured Likewise the saccule and the crista of the posterior canal were normal In this specimen, unfortunately the section showing the utricle and the superior semicircular canal were lost. The other two ears taken after seven weeks recovery showed no damage of the sensory structures either in the vestibule or the cochlea. The healing process in the fenestra (at the middle third of the semicircular canal) followed the same pattern as in the other chronic cases The cochlear responses of these two ears were within normal limits.

The animal in which bilateral electrocoagulation of the vestibule was carried out through a fenestra in the ampulla of the external semicircular canal was sacrificed 10 days after the operation It had developed bilateral otitis media and labyrinthitis on both sides The sensory structures of both vestibule and cochlea had disappeared, but on one side the supporting cells of the organ of Corti still remained normal These ears gave no electrical responses. These observations illustrate the special sensitivity of the hair cells to injury, in this case by infection, and also the well established dependence of the electrical responses on the integrity of the hair cells

DISCUSSION

Schall and Rambo[7] used a portable Bovie electrosurgical unit for coagulation of eight membranous labyrinths in five monkeys In one series of experiments the dial setting of the instrument was 20 The current was applied for one second and repeated within 10 seconds In another series the dial setting varied from 10 to 40 These animals were sacrificed after 30 days, while the other series were allowed to survive for periods of 10, 20, 30 and 40 days For a dial setting of 20 or more, they found the membranous labyrinth to be completely destroyed With a setting of 10 the saccule and utricle were incompletely destroyed and the semicircular canals undamaged They were unable to correlate damage to the cochlea with either length of postoperative life or intensity of the coagulating current

In our own experiments the microscopic examinations of the temporal bones show that we did not succeed in producing complete destruction of the vestibule either by surgical injury or electrocoagulation The crista of the posterior semicircular canal and the macula of the saccule remained even when coagulating currents of 40 to 45 milliamperes were used Unfortunately we did not keep enough animals alive long enough to be sure whether these structures would survive permanently or whether they might have degenerated several weeks after the operation

We have no reliable information as to strength of the coagulating current actually employed by various surgeons in Day's operation on the human The results are sometimes unsatisfactory, because after the operation patients sometimes complain of a vertigo, most frequently brought about by nodding the head This relation suggests that the posterior or the superior semicircular canal is still active It is possible that one or both of these canals escape coagulation just as the posterior (and sometimes the superior) canal did in our guinea pigs We believe that electrocautery should be applied several times to the vestibule and with various positions of the electrode in order to reach the posterior semicircular canal of the saccule The intensity of the current must be carefully regulated because it has little effect below 44 milliamperes An electrode insulated except for the tip should localize the current most effectively The insulation would prevent contact with bone at the fenestra and thereby reduce the probability of spread over the surface of the bone to the facial nerve.

In general the heating effect of a brief electrical current is related to its duration as well as to its intensity If brief currents are to be employed, the duration must, therefore, be regulated accurately The delay of two seconds required by the original Cameron Duo-Cauterodyne to warm up its filament makes it unsuitable for such brief dosage The current does not rise to effective strength for two seconds after operation of the foot switch. We suspect that in many human operations in which similarly designed instruments are employed, no actual electrocoagulation is produced The injury may be only from the insertion of the needle

Our microscopic examinations show that a rapid fibroblastic proliferation occurs which sometimes fills the entire closed section of the semicircular canal after two to three weeks. This overgrowth originates from the periosteum and the endosteum The great activity of the endosteal layer is probably stimulated by the surgical injury from the electrode. There is no such fibroblastic proliferation in the vestibule where the space is broad, and hence the injury to the periosteum is minimized.

Coagulating currents of high intensity elevated the thresholds of the cochlear microphonics and the action potentials The elevation of thresholds occurred in the cases that showed necrosis of the hair cells, but the response to 500 c.p.s was constantly affected whatever procedure was used and regardless of any abnormality of the hair cells This effect is probably produced by alteration of the acoustics of the inner ear when the new fenestra is opened. The new fenestra will obviously act like an acoustic leak, and it is reasonable that its effect should be greatest at the lowest frequency

SUMMARY

Electrocoagulation of the vestibule, following the general procedure of the Day operation for Ménière's disease was performed on 57 guinea pigs A special electronic switch was provided to limit the electrocoagulation to a predetermined time, usually 0 5 second Electrical responses to sound were studied immediately or after days or weeks of survival The temporal bones were later sectioned and examined microscopically

Currents less than 40 milliamperes flowing for 0 5 second produced little or no more damage than the mere insertion of the electrode Currents of 40 to 45 milliamperes produced necrosis of tissue near the needle track, but did not injure the posterior semicircular canal or the macula of the saccule Sometimes partial injury of the organ of Corti was produced by such doses

The elevations of electrical "thresholds," both cochlear microphonic and action potential, for frequencies 500, 2,000 and 8,000 c p s , correlate well with the degree of injury to the hair cells in various parts of the cochlea The cochlea was sometimes intact and electrical responses normal four to seven weeks after surgical injury, with or without electrocoagulation of the vestibule with 45 milliamperes for 0 5 second

The surgical fenestras in the labyrinth were closed by fibroblastic proliferation that filled the entire canal New bone was present four weeks after operation The endosteum as well as the periosteum seems to initiate this fibrosis and osteogenesis

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LATE CONGENITAL SYPHILIS OF THE EAR.*†

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There are relatively few diseases of the labyrinth whose pathology is well understood that cause progressive profound hearing loss in the apparently healthy young adult Malignant otosclerosis is one disease of this group, late congenital syphilis another The detailed description of the clinical symptoms and the temporal bone findings in late congenital syphilis by Mayer and Fraser,[1] in 1938, laid a firm foundation for this disease entity and separated it from other syphilitic disease of the ear [2] The main features in this disease are bone lesions of gummatous osteomyelitis These may invade the labyrinth to produce serous labyrinthitis associated with miliary gumma in the endosteum and dilatation of the cochlear duct and finally pronounced degeneration of the cochlear and vestibular end-organs

There may be productive inflammatory change in the perilymphatic space of the semicircular canals, sparing the endolymphatic space, and erosions of the endosteal layer of the bony canal may also occur The ossicles and the annular ligament may be invaded as well as the modiolus The histological appearance of the subendosteal periostitis of the semicircular canal indicated to Mayer and Fraser alternating periods of exacerbation and quiescence. While the incidence of this particular disease as a cause of deafness in the general population is now very low the incidence in young adults with profound bilateral progressive hearing loss excluding malignant otosclerosis, is significant. A re-examination of some of the problems associated with the diagnosis and treatment of this disease is presented Only a few studies have appeared in the literature in the past decade

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The ear symptoms usually develop rather abruptly long after other active manifestations of the congenital luetic infection have subsided

Despite apparently intensive early treatment and inactivation of early sites of infection, the temporal bone may suddenly become involved in a rapidly progressive disease during the second and third decade of life, even though the patient may be in apparently good general health A clinician actively involved in the treatment of lues may recognize its various manifestations The otologist, however, is usually consulted long after treatment has been terminated Indeed, the patient may have little awareness of the nature of the early infection Early manifestations may not be readily apparent Deformed teeth (Hutchinson's teeth) may have been capped or extracted Interstitial keratitis may have been very mild and after healing may have left very little signs A careful examination with a slit lamp may be necessary to find evidence of the corneal scars Blood serology may be equivocal or negative Laird,[3] in analyzing 115 cases of late congenital syphilis in England, points out that the diagnosis may be obvious or extremely difficult and that one seldom sees infantile syphilis now He found that over 80 per cent of the cases were diagnosed only after the first decade of life and usually because a disease appeared that suggested the need for a blood test

While there were positive eye findings in 61 of his patients, bilateral nerve deafness was noted in only eight Both sexes were equally affected in the eye disease, but seven of the eight cases of ear disease were in females

The direct examination of the ear and results of the auditory and vestibular tests and X-ray were not diagnostic in themselves In the presence of intact, relatively normal drums, the clinician would ordinarily not do a fistula test The presence of a positive fistula response is a rather unique feature of this disease first described by Hennebert[4] in 1911 The explanation for this phenomenon became clear later when the pathological changes in the temporal bone were described A hastily done fistula test with only positive pressure may show no eye movement or the eye movement may be so brief as to escape notice. Typical nystagmus may be evident only on negative pressure The nystagmus is usually of very short duration (one second) compared to that produced under similar pressure conditions in the ordinary labyrinth fistula (10 seconds) The gummatous invasion of the temporal bone marrow and blood vessel spaces is a striking feature of the disease as described by Mayer and Fraser Both proliferating and destructive changes occur in the capsule bone The labyrinth capsule bone may be riddled with miliary gumma even in the region of the annular ligament. Invasion of the ossicles themselves with secondary ankylosis of the incudomalleolar joint may add a conduction element to the deafness, but bony ankylosis at the stapes footplate was never seen The inflammatory change extends to the labyrinth itself to produce various degrees of chronic labyrinthitis to account for the severe auditory and vestibular symptoms. The symptomatology, however, is not particularly distinct and in itself cannot suggest the diagnosis Bilateral symmetrical profound progressive loss, often including low tones without remissions and with various degrees of tinnitus and vertigo is the clinical picture that these patients usually present. The findings in the patients studied are presented briefly, including audiograms and vestibular tests to help point out some of the problems in the diagnosis and treatment of this special luetic disease of the temporal bone.

Case 1 A. G female age 22 had onset of hearing trouble 11 years ago This became handicapping within a few months There was no tinnitus and only one episode of vertigo Severe interstitial keratitis occurred at age six requiring an iridectomy and producing some visual impairment. She received intensive antiluetic treatment at that time Hutchinson's teeth were present. The blood and spinal fluid serology were negative while under observation in the clinic.

The audiogram demonstrated a profound nerve type deafness bilaterally There was a marked impairment of the vestibular response to the cold caloric test. The fistula test was positive to negative pressure in both ears on repeated tests over the period of five years during which the patient was under observation.

A course of fever therapy had no effect upon the hearing The audiogram appeared to stabilize at a very high threshold (see Fig 1) A hearing aid was very effective and relieved tinnitus She was able to attend high school, get a job and married

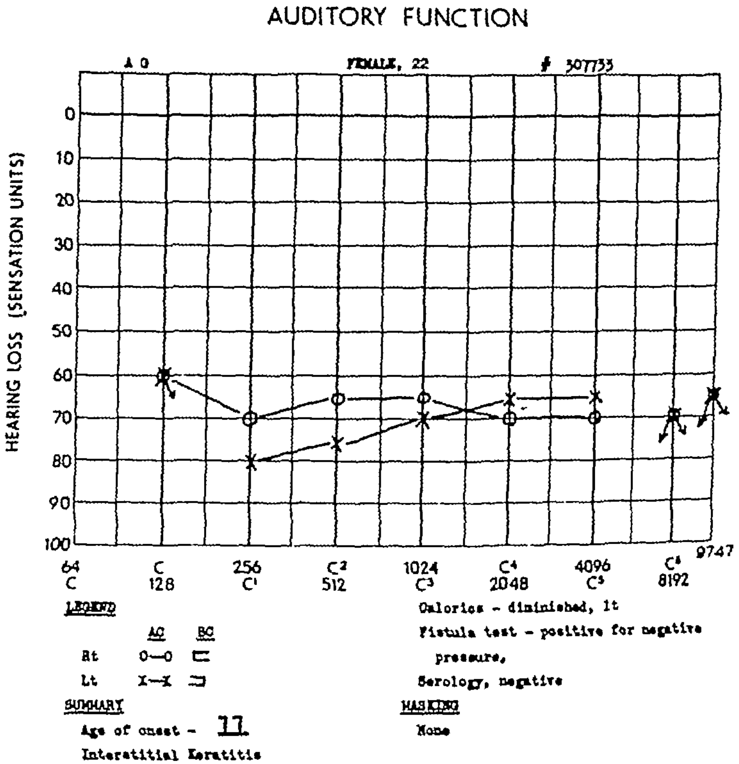


Fig 1 Audiogram of young woman 11 years after the onset of ear symptoms in late congenital syphilis. The hearing continued to deteriorate in the face of antiluetic and fever therapy No hearing by bone conduction could be elicited with the audiometer

Comment The response of the fistula to negative pressure is much stronger than that to positive pressure

Based on their pathological findings, Mayer and Fraser explain the fistula response in three different ways

1 A gummatous softening of the capsule from the outside and adjacent to the antrum

2 A gummatous penetration of the bony canal from the inside leading into a narrow space

3 A gummatous infiltration of the stapedial ligament producing abnormal mobility

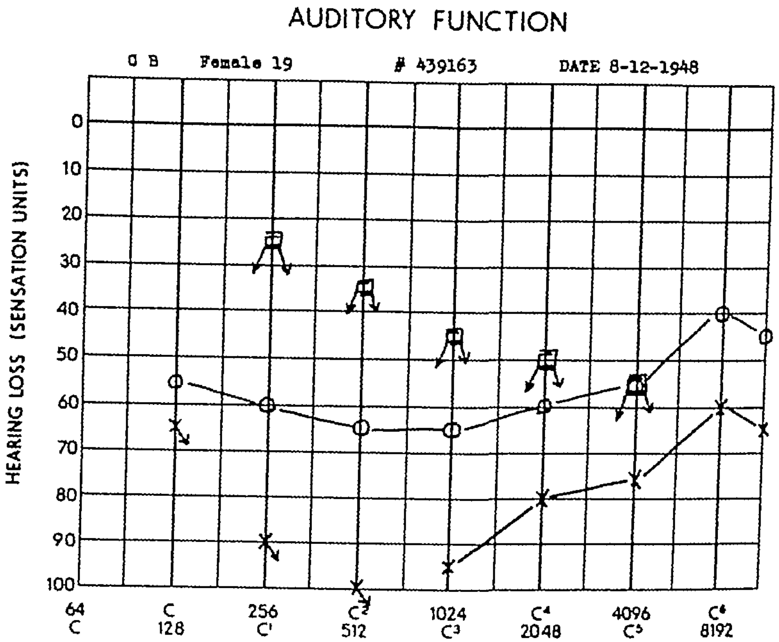
The production of eye movements on pneumatic movement of the intact drum and conducting mechanism is probably the result of unusual, abnormal mobility of the stapes due to invasion by granuloma of the capsule bone in relation to the annular ligament together with limited softening of the bony canal wall from the endosteal surface This explanation is supported by the fact that negative pressure is more effective than positive pressure in producing nystagmus Even the normal conducting mechanism is more easily moved by negative pressure than by positive pressure

The short duration of the fistula response is also a noteworthy feature. Only two to three large movements lasting about one second can usually be induced even with maintained negative pressure This suggests a different mechanism of vestibular irritation than that seen in the fistulas of the horizontal canal, where positive pressure is very effective in producing nystagmus and where the nystagmus lasts about 10 seconds with about 15 eye movements of gradually diminishing strength Despite the severe cochlear involvement, the vestibular apparatus was not destroyed The combined impairment of vision and hearing in this patient resulted in severe disorientation with her environment and led to an accident that killed her and her child Unlike some of the patients in this group, this patient went through a pregnancy without change in her hearing, but cochlear function was profoundly affected

Case 2 C. B., female, age 23 had onset of progressive deafness at age 17 Within three years the hearing loss was severe and the patient began to have tinnitus bilaterally and dizzy spells The hearing loss increased with these symptoms Evidence of inactive interstitial keratitis was present. The serology has been weakly positive. Interstitial keratitis was actively treated at age of seven.

The audiogram shows a severe bilateral rather flat perceptive hearing loss, while the minimal cold caloric tests were normal (see Fig 2) The fistula test was equivocal

The patient wears a hearing aid and received symptomatic treatment. Regular antiluetic therapy has been given repeatedly



LEGEND

	AC	BC
Rt	O—O	⊏
Lt	X—X	⊐

SUMMARY

Age of onset - 17

Tinnitus - constant, bil

Vertigo - intermittent

Interstitial Keratitis

Calorics - essentially normal bilaterally

Serology - positive

Suggestive Hutchinson's teeth

MASKING

BC - 70 db for both ears

AC - 70 db in right ear

Fig 2 Audiogram two years after onset of symptoms in a young woman with late congenital syphilis of the ear Despite intensive antiluetic therapy, the hearing continued to deteriorate and two years later the cochlear function on the left was completely destroyed

Comment Repeated and thorough antiluetic regimes did not stop the progression of the cochlear involvement, and the hearing in one ear was completely destroyed

Despite a normal caloric test, some disturbances in vestibular function were present in the patient, as indicated by the occurrence of attacks of vertigo

Case 3 B F, female, age 42, noticed a slowly progressive bilateral loss of hearing and slight tinnitus at age 18 At age 35 immediately following her first pregnancy the deafness became profound bilaterally and the tinnitus increased No vertigo occurred Before the onset of ear symptoms the patient had bilateral interstitial keratitis which became quiescent after treatment. A positive blood serology and negative spinal fluid were found at age 18 while during the period of rapidly progressing deafness the serology was only weakly positive or negative on repeated tests.

The original audiogram done in 1945 showed a severe deafness bilaterally Repeated hearing tests (see Fig 3) showed a moderate advancement of the cochlear disease. The cold caloric test was reduced on the first examination and was normal on the second On the right ear a fistula response could be obtained on both positive and negative pressure.

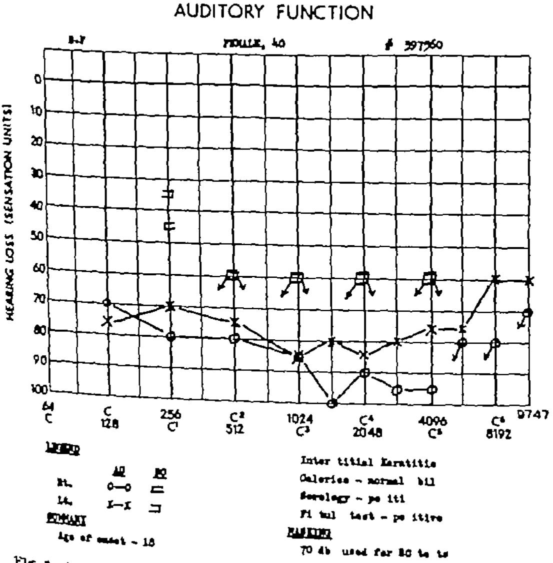


Fig. 3 Audiogram of patient with late congenital syphilis of the ear who noted a hearing loss for years which rapidly became worse after pregnancy and did not improve with intensive antiluetic therapy

Active antiluetic therapy including bismuth arsenic and penicillin during this time did not prevent continued deterioration of her hearing She obtained help from a hearing aid

Comment The sudden severe exacerbation of her deafness shortly after pregnancy is noteworthy

Case 4 R M L, female age 22 noticed tinnitus and associated loss of hearing at age 17 The hearing loss increased, especially in the right ear as the tinnitus subsided The hearing loss was accentuated during and after a pregnancy There was intermittent, transitory dizzy spells in the early period of the labyrinthine disease Hutchinson's teeth were observed The patient had inactive but handicapping luetic ocular disease that began at five years of age The serology was negative after treatment at age 11 The parents' serology was positive

A profound nerve type deafness was present bilaterally with a somewhat diminished response to the cold caloric tests There was spontaneous nystagmus to the left on head shaking The fistula test was positive to negative pressure on the left side

Despite further antiluetic therapy the hearing continued to deteriorate (see Fig 4)

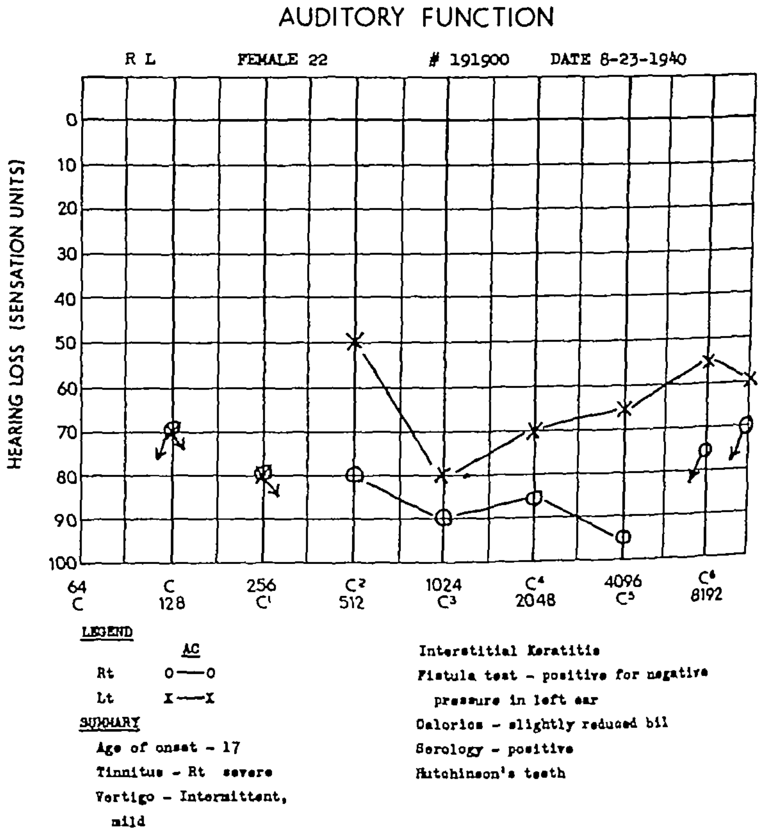


Fig 4 Audiogram of young woman with late congenital syphilis of the ear five years after the onset of ear symptoms Hearing by bone conduction was profoundly affected Antiluetic therapy did not stop the progression of the ear disease

Comment The progression of deafness in face of intensive antiluetic therapy is commonly observed Tamari[8] reported that despite the administration of 9,000,000 units of penicillin in 15 days, both the hearing and the vestibular function continued to deteriorate

On the other hand when the labyrinth function is profoundly affected, reversal of the labyrinthine pathology by any treatment is not likely

The profound cochlear loss in this patient contrasted to the mild vestibular impairment is in line with the clinical observation of apparent greater sensitivity of the auditory end-organs over the vestibular in labyrinthine inflammations The active fistula response to only negative pressure and the history of pregnancy influencing the progression of the deafness are again noteworthy

Case 5 C T., female age 40 noted tinnitus and loss of hearing in both ears at age 35 Following pregnancy at age 38 the hearing loss and tinnitus increased markedly Dizzy spells and headaches followed Suicide was contemplated. The serology has been weakly positive Interstitial keratitis occurred in the late teens but cleared quite well.

Cold caloric tests showed reduced sensitivity of the right vestibular apparatus only The fistula response was present on negative pressure in the right ear Intensive antiluetic therapy did not prevent deterioration of hearing.

In July of 1951 the patient received 100 mgm. of ACTH per day for seven days while on 600 000 units of penicillin daily for 10 days Pure tone acuity and speech discrimination thresholds were greatly improved.

This improvement has been maintained (see Fig 5) With the improved hearing there was an associated decrease in dizzy spells and headaches.

Comment Again pregnancy is seen to influence the activity of the disease. Therapeutic problems are discussed below

Case 6 V L female age 26 was well until the age of 23 when there was onset of severe tinnitus and frontal headaches These persisted for several months before decreased auditory acuity was notice on the left side followed by involvement of the right ear in a few months The hearing loss became progressively more severe in the months that followed. The patient then began to have intermittent dizzy spells and noted an impaired sense of balance more marked at night or in a dimly illuminated room. There was a history of keratitis at age of four The patient's mother had received antiluetic therapy just prior to the patient's birth.

General examination revealed a widespread vitiligo and a white patch of hair at the nuccal line There was a large inactive central perforation in the left eardrum

Except for inactive interstitial keratitis, iridocyclitis, vitiligo and poliosis, the general examination was negative

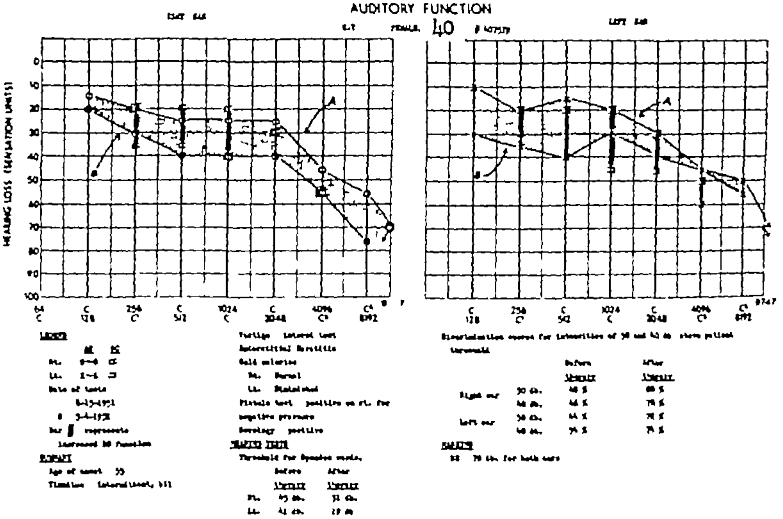


Fig 5 Audiograms of a patient with late congenital syphilis of the ear with five years of progressive symptoms markedly increased after pregnancy three years later and showing maintained improvement of function after a course of combined penicillin and ACTH therapy

There was a bilateral nerve type deafness, more severe on the left side, and bilaterally positive Rinnes with the Weber referred to the right ear There was no caloric response to ice water on the right and none to cold alcohol on the left. There was a spontaneous nystagmus to the right She had considerable difficulty in walking with the eyes closed The fistula test was negative at this time

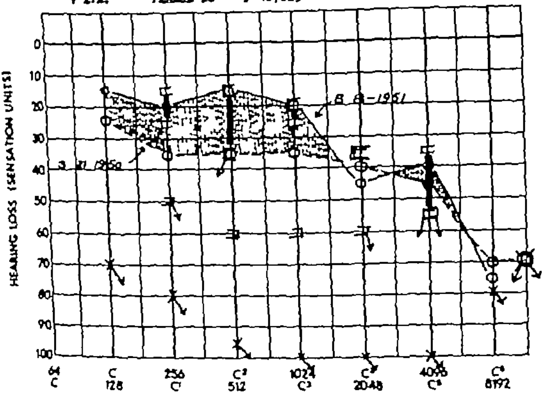
The blood serology was positive, while the spinal fluid was negative In view of the poliosis vitiligo uveitis and deafness a diagnosis of congenital lues and possibly Vogt koyanagi's syndrome was made

Unlike the other patients in this group, this patient after a full course of treatment with bismuth and arsenicals showed an improvement in the right or better hearing ear A positive fistula reaction was found at this time on the right side, both to positive and negative pressure In March, 1952, she received a combined course of ACTH and penicillin because the hearing had again deteriorated Twenty days later the threshold of the right ear was superior to any obtained in previous tests (see Fig 6) Tinnitus first decreased and then fluctuated a few days after therapy was started

Comment Uveoparotid fever, Cogan's and Vogt-koyanagi's syndromes may be associated with inner ear pathology pro-

AUDITORY FUNCTION

Y.E.A. FEMALE 26 # 487819 DATE 8-8-1951



LEGEND

	AC	BC
Rt.	o—o	⊏
Lt.	x—x	⊐

BC shift

HISTORY

Age of onset 23
Tinnitus present left ear
Vertigo mild
MT dry perforation, left
Interstitial Keratitis and Iridocyclitis
Poliosis
Calorics no response to ice water

Serology - positive
Fistula test positive
Recruitment suggested by discrimination scores

SPEECH TESTS

Threshold for spondee word on 8-8-1951
Rt. 29 db
Discrimination scores for intensities of 30 and 40 db above patient threshold

	30 db.	40 db.
Rt.	52 %	46 %

MASKING

BO 70 db for both ears
AC - 90 db in rt. ear while testing left

Fig. 6. Audiograms of a young woman with congenital syphilis showing total loss of cochlear function on the left side and moderate loss on the right after about three years of symptoms. The improved function in the right ear after a combined course of penicillin and ACTH therapy is represented. Some improvement was obtained before this by a course of bismuth and arsenicals.

ducing hearing and vestibular loss resembling that seen in late congenital syphilis and were seriously considered in the differential diagnosis in this case, however, the eye and ear symptoms in the above diseases are usually concomitant or follow one another rapidly Poliosis and vitiligo is part of the Vogt-koyanagi's syndrome and would be the most likely diagnosis in this case except for the typical history and findings of congenital syphilis and the positive fistula test

In considering the differential diagnosis in all these cases, one may also note that some familial diseases of the ear may manifest themselves long after birth to produce in a rather short time marked auditory and vestibular symptoms in the second to fourth decade of life These are inherited degenerative processes probably affecting the inner ear, often associated with other systemic disturbances

Case 7 M B, female, age 21 had onset of tinnitus at age nine Within two years the hearing acuity in both ears had decreased to a handicapping level The tinnitus persisted, and in the late teens transitory vertigo occurred The patient could make herself dizzy by pushing on the right tragus Bitemporal and parietal headaches have been severe in the past three years

There was a history of a positive serology in the patient at the age of nine Her mother had had a positive serology The patient had interstitial keratitis but this is now inactive The patient's blood and spinal fluid serology are negative at present

Hearing tests showed a profound bilateral perceptive deafness (see Fig 7) The response to the cold caloric test was reduced only in the left ear There was a slightly positive fistula test to negative pressure in the left ear

The patient received a combined course of ACTH and penicillin for seven days with no effect on auditory symptoms or function

Case 8 A C male age 24 had onset of deafness in the right ear at age 12 This progressed in a few years to an inadequate level and soon the left ear became involved A hearing aid was fairly satisfactory until age 23 when the hearing suddenly deteriorated with an acute 'flu'

The patient had interstitial keratitis in 1938 several years before the beginning of ear symptoms and received antiluetic treatment at that time The mother was a known luetic

The routine clinical examination was noncontributory Hearing tests showed apparent total loss of cochlear function, yet tinnitus was present and sometimes was severe (see Fig 8) There was no response to ice water in either ear The fistula test was questionable in the right ear

A course of continued ACTH and penicillin treatment was given without effect.

Comment When the gummatous lesions reach the labyrinth spaces, a rapid progression of symptoms may be expected as labyrinthitis rapidly develops The profound loss of vestibular function together with apparent total hearing loss indicates a very extensive irreversible labyrinthine infection. The presence of severe tinnitus despite the absence of cochlear function is noteworthy

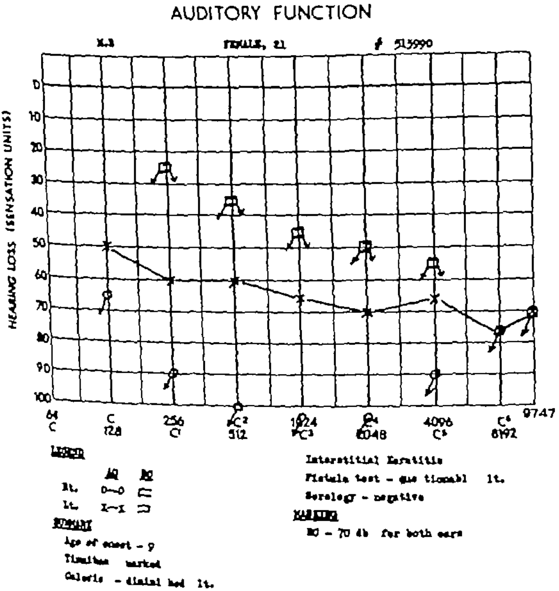
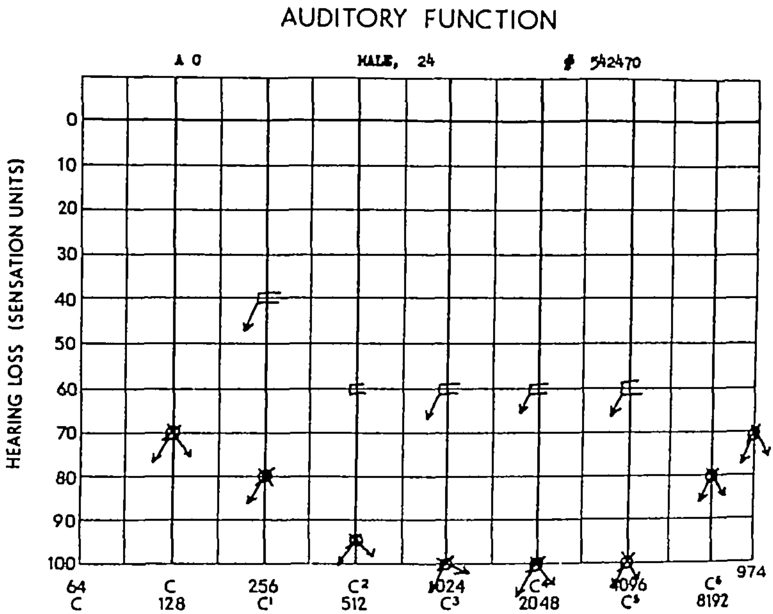


Fig. 7 Audiogram of a young woman with 12 years of progressive ear disease due to congenital syphilis not changed by combined penicillin and ACTH therapy

Case 9 N P female age 29 had onset of progressive deafness at 19 years of age Initially the deafness involved the left ear but, following a pregnancy in 1947 the hearing in the right ear dropped The bilateral nerve type deafness then remained essentially stationary Tinnitus was relatively mild and history of vertigo was vague. Associated with the hearing loss was an inactive luetic interstitial keratitis Positive blood serology and negative cerebrospinal fluid serology were found.

Inactive middle ear disease was camouflaged by the profound nerve type deafness. The fistula test was strongly positive on negative pressure on the left side and weakly positive to positive pressure.



LEGEND

	AC	BC
Rt	O—O	⊏
Lt	X—X	⊐

SUMMARY

Age of onset - 12

Calorics - no responses, bil

Interstitial Keratitis

Fistula test - questionable, rt

Serology - negative

MASKING

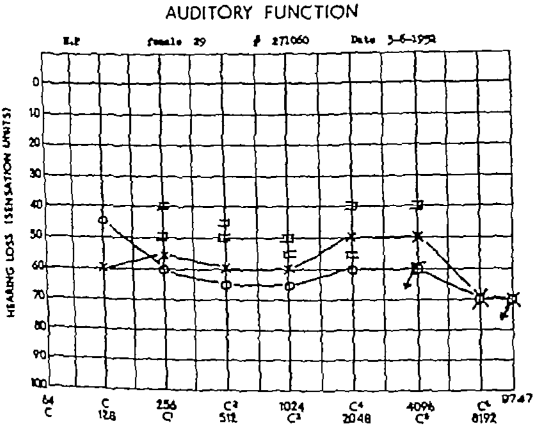
BC - 70 db for both ears

Fig 8 Audiogram of young man with 12 years of progressive ear disease due to congenital syphilis leading to total destruction of cochlear function. No response was obtained by a course of combined penicillin and ACTH therapy

Arsenic and bismuth therapy was ineffective in changing the hearing acuity The patient was treated recently with ACTH and penicillin The pure tone threshold curves were not changed, but speech discrimination tests suggested a significant improvement in the ear with the poorer threshold curve (see Fig 9)

Case 10 E H, female, age 41, had onset of vertigo with tinnitus and hearing loss at age 33 while receiving antiluetic therapy for a second attack of interstitial keratitis The dizzy spells often seemed related to position changes Nystagmus to left with vertigo lasting about two minutes when the patient is lying on the right was noted on Aug 9, 1950 With each dizzy spell, the hearing seemed to become worse

The patient became aware of her lues at age 20 when she developed interstitial keratitis The mother and brothers were also found to be luetics at this time Treatment was given Interstitial keratitis recurred 10 years later The blood serology has been weakly positive over the years



LEGEND

	AC	BC
Rt.	O—O	⊏
Lt.	X—X	⊐

[illegible]

Age of onset 19

Vertigo - intermittent, mild

Interstitial Keratitis

Serology positive

Fistula test positi

[illegible]

Threshold for spondee words

Rt. 66 db.

Lt. 65 db.

Discrimination score for tested intens-
ities above the normal threshold

	Intensity	Before therapy	After therapy
	78 db.	4 %	50 %
Rt.	88 db.	16 %	58 %
	98 db	30 %	48 %
	78 db	00 %	4 %
Lt.	88 db	4 %	6 %
	98 db.	4 %	12 %

[illegible]

30 - 70 db. for both ears

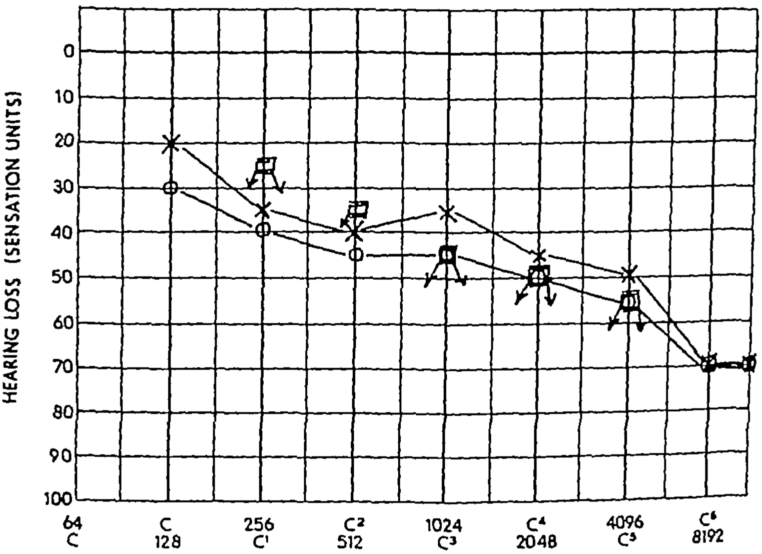
Fig 9 Audiogram of young woman with 10 years of progressive ear disease due to congenital syphilis that did not respond to extended standard antiluetic therapy over this period. A subsequent course of combined penicillin and ACTH therapy was also without clear cut effect.

The threshold curves showed a bilateral moderately sloped perceptive loss (see Fig. 10) The cold caloric test showed profound loss on the left and moderate loss on the right ear Positional changes especially head shaking induced vertigo and spontaneous nystagmus to the left. Negative pressure to each ear caused a weakly positive fistula reaction with subjective vertigo

Comment The observed histopathology of late congenital syphilis of the ear suggests that changes in the endolymphatic system of the labyrinth, *i e* dilatation of cochlear duct secondary to invasion of the labyrinth capsule and perilymphatic space by the spirochete may have some resemblance to the changes reported in Menière's disease and may account for occasional similarity of the clinical picture

AUDITORY FUNCTION

E H FEMALE 41 # 489083 DATE 5-9-1950



LEGEND

	AC	BC
Rt	O—O	⊏
Lt	X—X	⊐

SUMMARY

Age of onset - 33

Tinnitus - variable

Interstitial Keratitis

Caloric response

Rt - moderate reduction

Lt - marked reduction

Fistula test - weakly positive

Nystagmus to left and vertigo when patient in right prone position

Serology - positive

MASKING

BO a 70 db for both ears

Fig 10 Audiogram of a patient with eight years of ear disease An attack of interstitial keratitis led to the diagnosis of congenital syphilis at age 20 Her mother and brothers were found to be luetics at this time She was extensively treated but keratitis recurred at 33 and ear symptoms began at this time

Case 11 C W, male, age 35, was a known congenital luetic with positive serology even after intensive treatment at the clinic for the four years preceding the onset of deafness and tinnitus in the *right ear* A year later the patient began to have attacks of vertigo The hearing test showed a flat nerve loss on the right with a practically normal curve on the left. The caloric test, however showed no response to ice water on the normal hearing side and a normal response on the side showing deafness. The fistula test was negative There was a history of earlier inflammation of the eye but no evidence of interstitial keratitis was found. There is however a suggestion of Hutchinson's teeth. The mother was a known luetic.

Comment While this case is included in this report as a known congenital luetic with auditory and vestibular symptoms, the clinical picture is *not* typical of the group The nature of the right ear deafness and dizziness beginning in the fourth decade is typical of Ménière's disease and may have no relation to the known congenital lues with continued positive serology The absence of a fistula response is not diagnostic, since Hennebert reported that the fistula response was negative in the male with late congenital syphilis of the ear More suggestive of some unusual inner ear disease in this patient is the total absence of the caloric response on the opposite practically normal hearing ear The absence of positive serology in the spinal fluid in this patient, and in others of this group indicates that the meningeal change is not a primary factor in this luetic disease of the ear which begins primarily as a gummatous osteomyelitis of the temporal bone. The major findings in all the above cases are indicated in Table 1

Discussion Like otosclerosis, this disease might be present in the temporal bone for some time before symptoms become manifest. Goodhill[6] found histopathological changes in the temporal bones of luetic infants In those who survive lesions may remain dormant and asymptomatic for years, but finally with invasion of the labyrinth capsule, modiolus or ossicular chain symptoms appear and progress with varying rapidity

The extremely rapid progression of the deafness seen in some of these cases may be due to the widespread serous labyrinthitis initiated when the inflammatory process finally extends through the labyrinth capsule into the labyrinth spaces.

Invasion of the ganglion and nerves in the modiolus may be another important factor in determining the particular course of the disease

TABLE 1 FINDINGS IN THE PATIENTS DESCRIBED

	Family History	Serology	Interstitial Keratitis	Teeth	Age of Onset
1 agk	?	—	+	+	11
2 cb	+	+	+	+	17
3 bf	?	+	+	—	18
4 rl	+	—	+	+	17
5 ct	?	+	+	—	35
6 va	+	+	+	—	23
7 mb	?	—	+	—	9
8 ac	+	—	+	—	12
9 np	+	+	+	—	19
10 eh	+	+	+	—	33
11 cw	+	+	—	+	31

	Tinnitus	Vertigo	Fistula Test Pressure		Caloric		Effect of Pregnancy
			Positive	Negative	Normal	Abnormal	
1 agk	—	—	—	+		+	—
2 cb	+	+	—	+	+		+
3 bf	+	—	+	+		+	+
4 rl	+	+	—	+		+	+
5 ct	+	+	—	+		+	+
6 va	+	+	+	+		+	—
7 mb	+	+		?		+	
8 ac	+	+	—	?		+	
9 np	—	—	—	+		+	+
10 eh	+	+		+		+	—
11 cw	+	+	—	—		+	

Despite the widespread striking histological changes in the temporal bone demonstrated by Mayer and Fraser, careful X-ray studies have failed to demonstrate them Spinal fluid serology has been negative in all these cases, confirming their opinion that meningeal activity was not an important factor in the disease

The high incidence of this disease in the female is definite, but difficult to explain, as is the aggravation of the symptoms by pregnancy The particular metabolic changes and endocrine imbalance associated with pregnancy sometimes leads to aggravation of chronic systemic infections Clinical observation indicates that local infections like chronic sinusitis or otitis media may become more active and severe during pregnancy The osteomyelitic gumma in the temporal bone and the labyrinth inflammation may thus be activated by pregnancy Since clinical observations indicate that infections may be more severe while patients are under ACTH therapy, the presence of additional ACTH in the blood during pregnancy may be related to the observed progression of the luetic ear diseases at this time. The question of advising against pregnancy even during the inactive stages of this ear disease is worthy of consideration When the patient is seen during pregnancy it may be advisable to give intensive antiluetic treatment, particularly with the signs of reactivation of the infection

Vestibular symptoms as well as abnormalities of vestibular tests are the result of the many degrees of inflammatory changes in the vestibular part of the labyrinth so carefully described by Mayer and Fraser The positive fistula response with an intact drum is a unique feature of this disease and is related to the observed erosions of the capsule bone in the vestibular labyrinth and oval window The ossicular chain probably transmits the pressure in the fistula test and this may explain the marked difference between positive and negative pressure in producing nystagmus Often there is no response at all even with very strong positive pressure The greater sensitivity to negative pressure is in line with the greater sensitivity of the ossicular chain to displacement by negative static and acoustic pressure accentuated at the stapes. The short duration of the induced nystagmus indicates difficulty in maintaining deviation of the cupula by movement of the stapes (see Fig 11) Tammari reports that the fistula test was negative in all eight of his cases while the majority of our patients gave a positive fistula response when negative pressure was used

The rational of ACTH therapy combined with known antiluetic drugs, is the observation that ACTH tends to reduce fibroblast and connective tissue reaction at an inflammatory site. The widespread inflammatory reaction within the labyrinth might be diminished and a similar effect on the luetic lesions in the temporal bone may tend to facilitate approach of the therapeutic agent in the blood stream Any reduction of this connective tissue barrier to the gummatous foci may reactivate them but this is controlled by the simultaneous administration of the antiluetic drug Mayer[7] believed that

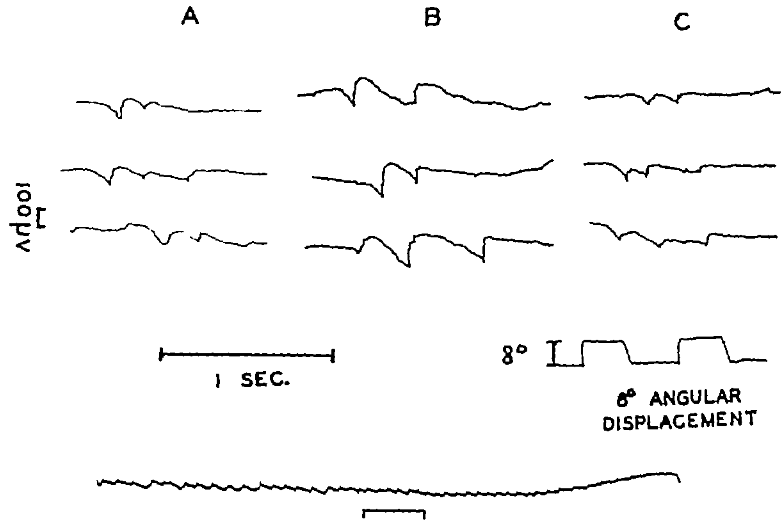


Fig 11 Record of eye movement induced only by maintained negative pressure in the external canal in the case (NP) of late congenital syphilis of the ear (A) Eyes open (B) Eyes closed (C) Eyes open but covered with Bartel s glasses

Note that for each stimulus about three eye movements are produced lasting altogether about one second. The movements are larger when the eyes are closed. Compare with record of voluntary eight degree displacement—lower right. More than 10 times as many eye movements lasting about 10 seconds are produced by similar pressure on a fistula of the horizontal canal in chronic mastoiditis (see lowest tracing Note different calibration) Note Records made with the cooperation of Dr T Case

the failure of ordinary antiluetic treatment in this disease is due to the spirochetes being buried in the inactive capsule and he proposed to reactivate this bone and thus mobilize the spirochete so that it might be attacked by the antiluetic drug He cited the experiments of others who produced changes in the labyrinth capsule bone and he proposed a low calcium diet free of vitamin D together with salvarsan as a method of treatment of late congenital syphilis of the ear

The series of cases here reported receiving combined therapy are of course altogether too limited and the duration of observation too short to permit any conclusions This disease is so serious, however (complete loss of cochlear and vestibular function may occur), and so resistant to standard therapy that an early test with the combined ACTH and penicillin treatment should be considered Under the combined therapy none of the patients showed further deterioration Some were so severely deafened that irreversible pathology was probably present which could not be affected by treatment.

SUMMARY

Eleven cases of congenital syphilis that developed ear symptoms were studied This ear disease affects young women particularly and is often rapidly accelerated by pregnancy

The auditory and vestibular symptoms and the results of functional tests are compatible with the bone and labyrinth pathology described by Mayer and Fraser

A positive fistula test in the presence of an intact normal drum is a distinctive sign in this disease The response is obtained particularly with negative pressure in the external canal Unlike the usual fistula response the duration of the induced nystagmus in these cases is usually very brief There are about three eye movements lasting about one second

This ear disease is resistant to antiluetic therapy and may even progress rapidly to profound loss of function during intensive treatment. From a consideration of the special pathology and observations on a few of the patients studied in this report, treatment with penicillin and ACTH when given in early stages appears to offer some prospect for improvement

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MASKING AND FATIGUE EFFECT OF WHITE NOISE IN CONNECTION WITH SPEECH TESTS *

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The masking effect of noise on the perception of speech has been amply and accurately covered by many authors, with reference to the rational and appropriate employment of the type of masking tone used, less information is available, as most authors in their experiments used the masking tone normally found in ordinary audiometers, this generally comprises a tone spectrum in which low frequencies predominate.

The introduction of white noise undoubtedly presents a progress in that it enables a masking tone to be used, covering with equal distribution the whole frequency spectrum It would be well to remember that the term ‘ white noise” or ‘thermal noise’ is derived from the fact that the thermal agitation of electrons in a resistance gives rise to a variable potential across the ends of the resistance itself, the variations are distributed uniformly to cover the frequency spectrum For our experiments we used an Elit white noise generator supplying a maximum output of approximately 10 mW with a 600 ohm resistance The power supplied by this generator is uniformly distributed between 40 and 10,000 c.s within limits of ±4 db, as measured with a General Radio wave analyzer (see Fig 1)

Using the above apparatus, it was our intention to study the masking and fatigue effect of white noise, no longer using headphones and monaural reception as had been used previ-

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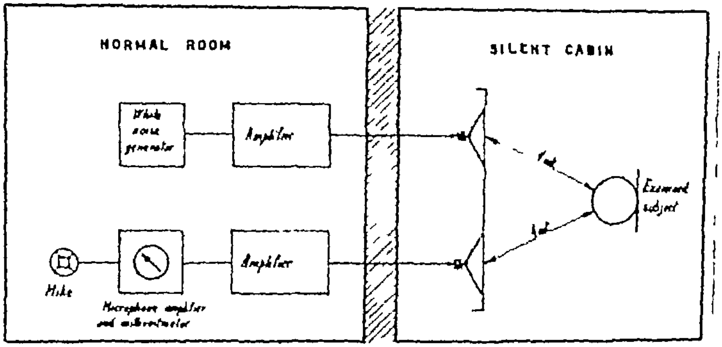
ously by Hawkins and Stevens, Egan, Pollack, but with a loudspeaker acting in free field and using logatomes as test material *

FIG 1



Our research refers to 12 selected subjects with normal hearing The following research method was adopted the subject was made to enter a silent cabin and to sit one meter from the two loudspeakers placed one above the other (one emitted white noise while the other transmitted logatomes), the examiner, outside the silent cabin, was thus able to carry out the articulation curve for logatomes in silent conditions By switching on the white noise generator, he was able to repeat the articulation curves at the following fixed intensity levels of white noise 20, 40, 60, 80 db above normal threshold

Having finished this first part of the test and under identical conditions as previously, the subject being examined was required to listen to the white noise signal strongly amplified (in some cases 60 db, in others 80 db) for 15 minutes with the intention of introducing a state of fatigue, after which

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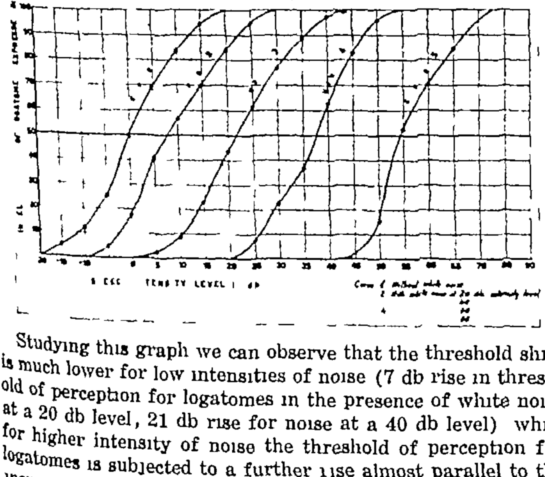
*As phonetical materials were chosen the logatomes constituting an ideal phonetic material where research assumes an essential clinical character as they are a suitable stimulus to the ear only, without interesting superior psychical centers and without identification of the stimulus involving a definite mental engagement. Italian is one of the few languages in the world allowing the use of certain logatomes without subjects being requested to know the so-called phonetic alphabet In the Italian language there is indeed a rather constant correspondence between some graphical signs and the relating phonetic sounds the articulation curve was repeated once more in the presence of white noise at the same fatiguing level, and yet again immediately after the noise had been switched off

We will now consider the results obtained during the first part of our research, i e , those dealing with the raising of the perception threshold for logatomes in the presence of white noise at varying intensities (in other words, the "threshold shift"), which has already been studied by Hawkins and Stevens for pure tones and for connected discourse in the presence of white noise and, in Italy, by Azzi, in the presence of the masking tone of a normal audiometer (see Fig 2)

FIG 2



Studying this graph we can observe that the threshold shift is much lower for low intensities of noise (7 db rise in threshold of perception for logatomes in the presence of white noise at a 20 db level, 21 db rise for noise at a 40 db level) while for higher intensity of noise the threshold of perception for logatomes is subjected to a further rise almost parallel to the increase in intensity of the noise itself (38 db for 60 db level of white noise and 55 db for 80 db level of white noise)

The above results signify that for low levels of masking noise the ear retains sufficient resolutive power" to oppose the masking effect of the noise itself, while for higher noise levels the masking effect is almost complete

The results show, therefore, that the masking effect on logatomes does not proceed in a strictly linear fashion as in the case of pure tone in the presence of the masking tone of a normal audiometer, but according to a curve which initially takes the form of a parabola, while the latter tends to run parallel to the straight curve representing the behavior of the phenomenon for pure tones This is clearly demonstrated in Graph 3

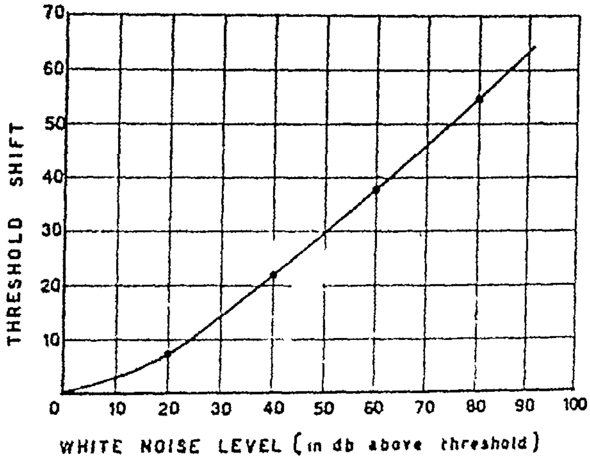


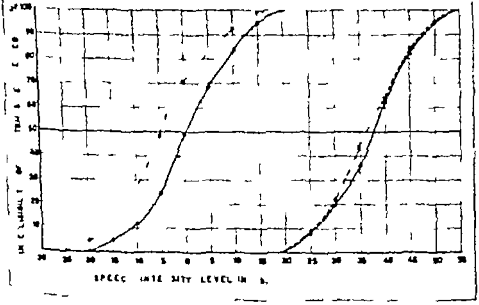
FIG. 3

The above affirmation is confirmed in practice by the fact that long distance telephone conversation can be affected in the presence of low background noise level, the noise itself not having sufficient masking effect to impede speech perception

Naturally the resolutive power of the ear is not equal for all subjects with normal hearing, for this reason the threshold shift in the presence of white noise can be recommended as a useful test when selecting personnel for certain occupations where good discriminatory faculties are of the maximum importance (telephone operators, radiotelephone operators, echo-sounding operators, etc) We are here referring, however, to a test which is of interest not only to the otologist but also to the psychologist, since the results obtained depend also upon the phychological factoi, the mental response, and in some degree also upon the standard of education of the subject examined

The second part of our research, that dealing with the fatiguing effect of white noise, has provided us with real surprises the articulation curve repeated after 15 minutes of continuous white noise at a high intensity level (in some cases at the 60 db, in others at the 80 db level) proved to coincide perfectly with the curve taken in the presence of white noise at the same intensity level before the fatiguing test took place, thus showing that exposure to white noise at the levels used and for the period of time mentioned produces no fatiguing effect whatsoever (see Graph 4)

FIG 4



The articulation curve taken immediately after the cessation of white noise has shown that where we expected to find a rise in threshold of perception we found instead a slight lowering of the threshold itself, almost as though the white noise had a "sensitizing" effect rather than a 'fatiguing" effect.

Egan had already found a similar phenomenon but in different experimental conditions i e, with binaural headphones The subject being examined was made to listen to white noise at a low level of intensity (45 to 50 db) through one of the phones, while the other was used to transmit connected discourse The A found that when introducing white noise in a phone, perception of connected discourse in the opposite ear was some 5 db better The hypothetical explanation was that the phenomenon was due either to the reflexed contraction of the middle ear muscles of the opposite ear, or else to the fact that as white noise contains all the frequency bands found in common speech, these bands act to reinforce the intensity of the speech fed to the opposite ear It should be noted, however, that the results reported by Egan were later refuted by Pollack.

In conclusion, the hypotheses which can be advanced to explain the phenomenon observed by ourselves can be listed as follows

1 Reduction of the muscular tone of the middle ear muscles, and in particular of the stapedium, due to the fatigue of the muscles caused by the prolonged stimulation to which they have been subjected This hypothesis should be linked to the phenomenon of "hyperacusis dolorosa" observed in many cases where facial nerve palsy produces consequent palsy of the stapedium

2 Accumulation of chemical mediators of the nervous system, caused by the sound stimulus, which facilitate the transmission of the sound current through the interneuronic synapsis

3 Psychic effect due to the absolute and sudden silence following a condition of high intensity prolonged noise, causing the subject better to perceive speech, both subjectively and objectively

We are not in possession of experimental data to confirm the first two hypotheses All subjects examined spontaneously observed that they had the subjective sensation of "hearing better", what is more important, however, is that their observations are not only subjective but objective and clearly demonstrated by Fig 4 Neither is it possible to raise the objection that they heard better because of their increasing familiarity with logatomes used throughout the test, first, because our subjects were selected from persons with a good standard of intelligence, who, in the majority of cases, were already familiar with logatomes, second, because the same subject was never presented twice with the same list of logatomes (10 per list) We were in possession of numerous phonetically balanced and, therefore, interchangeable lists

Another objection which could be raised is that if white noise at 80 db intensity level gave rise to fatigue phenomenon, such fatigue could not, in practice, be prolonged over 30 to 35 seconds starting from the moment when the noise itself ceased, while a complete articulation curve takes at least 60 to 70 seconds to complete To these objections we can reply as follows

1 Immediately after the white noise ceased, we started taking the articulation curve, beginning at the value of intensity which we had found to correspond with the threshold of perception at the start of the test This enabled us to bring out eventual differences between the two perception thresholds in less than 15 to 20 seconds

2 Even if we were unable to comply with the time limit as above, we would in any case have found, in the absence of fatigue phenomenon, complete coincidence between the two curves, and not that slight, definite and constant difference which we observed in all our 12 cases

To conclude briefly, the real reason producing the phenomenon observed by us is still unrecognized and for this reason we limit ourselves to reporting it. Further physiological and, above all, physiopathological studies of hearing might give us a better explanation, for this reason we propose to study how the phenomenon and also how the threshold shift, so far observed to be present in subjects with normal hearing behave in cases of otosclerosis and in nerve deafness

SUMMARY

The authors determined the behavior of threshold shift produced by white noise in speech tests with logatomes After

having noted that such shift is proportionately greater for high intensities of white noise, they described the particular phenomenon whereby the ear gains in sensitivity due to white noise They indicate some explanatory hypothesis of the above phenomenon

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AIR EMBOLISM DURING LAVAGE OF THE MAXILLARY SINUS A REPORT OF TWO CASES *

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Although the lavage of the maxillary sinus is a simple routine diagnostic and therapeutic procedure, complications can and do occur at infrequent intervals The most serious and most terrifying complication of this procedure is an air embolism. The suddenness of onset, the terrifying train of symptoms and events that follow, the utter helplessness that the otolaryngologist feels and the serious consequences that may follow produce a picture that is unforgettable. To have a relatively healthy individual walk into the office for this simple procedure and then to have a person carried out on a stretcher either dead or unconscious magnifies the gravity of the situation, and justly so This makes it all the more important that we examine all the factors and ask ourselves why this complication occurs and what can be done to prevent it. Certainly, it is our duty and an obligation to our patients that we make this procedure completely safe, so that their health and their lives will be safeguarded.

Grove[1] in his excellent article, gives a historical resume of the introduction of the lavage of the maxillary sinus through the various routes It was Copedepont who in 1894, was the first to introduce the injection of air into the maxillary sinus. Since then it was and still is the practice of many otolaryngologists to insufflate air into the maxillary sinus Some injected air into the antrum to determine whether the needlepoint is within the maxillary sinus If the needlepoint is in the sinus, a peculiar gurgling sound of air entering the sinus was supposed to be heard After the irrigating fluid

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air was insufflated into the sinus to force out the fluid and whatever mucus plugs are present The majority of otolaryngologists do not inject air before the irrigating fluid, but many do so after, in order to dry out the sinus This practice of injecting air into the antrum has led to a number of very serious and even fatal complications

It was Hajek[2] who, in 1907 at the German Laryngological Society, was the first to refer to this very serious complication which he observed during lavage of the maxillary sinus He attributed this to an irritation of the vagus, cocaine poisoning, hysteroepilepsy and epilepsy From then on, numerous similar cases were reported, some of which led to death and others to recovery All of these had the same train of symptoms, which were characterized by a sudden collapse into unconsciousness, cyanosis, pulse and respiratory changes, tonic and clonic contractures of various groups of muscles and indeed, all muscles, and muscular twitchings No logical explanation was given for this complication and the cause was variously reported to have been due to cocaine poisoning, or a nasal reflex neurosis which was due to an irritation of the vagus through the trigeminal nerve in the nose

Bowen,[3] of Toronto, in 1913, reported two cases of air embolism following antral lavages In the first case, a female became unconscious and had convulsions following a puncture of the antrum and the inflation of air She recovered after being unconscious for five days The second case, a male had a puncture of the antrum and immediately after the insufflation of air became unconscious, had convulsions and died within an hour At autopsy, the heart was markedly distended A hissing sound was heard when the pulmonary artery was opened and the distended heart collapsed The puncture of the antral wall was easily found and when the anterior wall was removed, the mucous membrane of the roof, except for a small part, as well as the outer and inner walls was found detached The mucous membrane covering the roof was hanging about a quarter of an inch below, and it showed a small puncture mark The bone of the roof and posterior wall did not show any puncture mark Consequently, the needle did not puncture beyond the antrum Bowen postulated that the needle punctured the mucous membrane of the roof, and the air was forced between the mucous membrane and bone, opening up numerous capillaries, thus allowing the air to pass into the general circulation

Boenninghaus[4] and Gording,[5] in 1920, were the first to point out that the cause of these serious symptoms was an air embolism. Boenninghaus found that all these cases had one thing in common the symptoms usually followed injection of air into the maxillary sinus He expressed himself as not believing that these mishaps were due to cocaine and novocaine poisoning While he did not deny that vagus excitation may arise from too strong air pressure or too cold an irrigating fluid, he did not believe it possible for this factor to function to such a degree as to produce an actual death He reported 11 fatal cases in which autopsies were performed and concluded that the air reaches the right heart through the facial veins by the internal jugular vein, but that it may also cause death by hitting the breathing center in the medulla.

Gording,[5] in 1920, collected nine cases from the literature and reported four of his personal cases and another three related to him by his colleagues. There was one death in his own four cases He felt that the cause of the trouble was an air embolism and was able to prove this experimentally in rabbits. By injecting air into the maxillary sinus of the rabbits he could produce changes in the respiration down to complete cessation although no changes in the pulse were noted In one of his rabbits, he produced respiratory changes on irrigating one antrum but on irrigating the other side convulsions and death ensued At autopsy it was seen that an incomplete puncture had been done and that the mucosa of the sinus had been stripped from the nasal wall, occasioning bleeding There were air emboli in the right heart and in the general circulation He concluded that in thick walled antra where the puncture is made with difficulty, it is possible to loosen the mucous membrane from the underlying bone and open up the blood vessels In these cases the mucosa is pushed ahead of the needle and on inflation air is then directly forced into the circulation, therefore, he assumed that in the cases where the bony wall was thick and collapse came on immediately after inflation, the cause was air embolism In the other cases where the bony wall was thin and the symptoms did not come on until actual syringing began, he assumed that a trigeminal reflex could be the cause of the catastrophe Grove[1] does not believe that this latter point is correct because with the syringe used, very little time is lost between the cessation of the inflation and the beginning of the irrigations, and it might easily take the small interval of time for air which had entered the circulation during the inflation to reach the coronaries or vessels of the medulla

Grove,[1] in 1922, made a most complete and exhaustive study of the subject He was able to collect 42 cases of air embolism following antral lavage Of these cases, there were 15 deaths, 11 of which occurred immediately or within a few hours to 36 hours In these fifteen cases, seven followed a puncture through the inferior meatus, three from the middle meatus, while in five cases the route was not mentioned In the autopsies done on eight of these cases, three were entirely negative, in two cases minute hemorrhages or signs of stasis were found in the circulation In a second group of 25 cases the chain of symptoms was the same except for the fact that the patients all recovered after a harrowing experience In these cases the puncture was done through the inferior meatus in 15 cases, through the middle meatus in two cases, and in eight cases the route was not mentioned In the next six cases the common symptom was transitory blindness The most classical example of this was the case cited by Caesar Hirsch,[6] of a 16-year-old girl who, after lavage of the antrum, complained of a sudden inability to see out of one eye The pupil in that eye was immobile, but no pain was complained of An opththalmoscopic examination revealed a pale optic disc, grayish retina and normal retinal veins In the arteries, bubbles of air were plainly visible, separated from each other by columns of blood slowly moving After two or three minutes, the air left the arteries, the retina assumed a more normal color and the disc lost its distinct pallor The activity of the pupil and the sight also returned In these six cases, two followed a puncture through the inferior meatus, three from the middle meatus and in one the route was not mentioned.

Since writing his paper Grove's attention was called to two more cases of collapse during inflation from the practice of two of his colleagues and one case from the literature J C Coffey,[7] of Milwaukee, reported a case of a 54-year-old female in whom, after cocainization, a puncture of the right antrum through the inferior meatus and an irrigation of normal saline was done without incident. The procedure was repeated on the other side with the same anesthesia Considerable resistance was met in attempting to force the water into the antrum, and this caused the patient some pain At the same time only very little water returned. The patient collapsed, became cyanotic and unconscious, with convulsive movements. Death seemed imminent, but the patient recovered after half an hour

Richard Meunzer,[8] of Milwaukee reported a case of an 18-year-old woman who had a puncture of the left antrum air inflation and then was irrigated with normal saline Upon drying out the cavity with air, the patient suddenly collapsed and became dyspneic and had twitchings of the muscles She recovered in two hours A second puncture repeated a week later produced the same train of symptoms

H L Lanier[9] reported a case of a 52 year-old female who had a puncture of the left antrum through the inferior meatus under 10 per cent cocaine anesthesia The puncture was done quickly and easily and the first few injections of air passed through the antrum without resistance Several compressions of the bulb were made in rapid succession when a mucopurulent mass was blown out through the maxillary ostium. After the ostium again appeared to be blocked more air was insufflated The patient fell prostrate became cyanotic the pulse was small and hardly perceptible and the respirations became irregular and shallow The patient remained in this state for three hours and then regained consciousness.

Since Grove's article there has been a paucity of reports in the literature Bacher,[10] in 1923, reported a fatal case with autopsy findings corroborating the results Cavanaugh,[11] in 1925, reported a case of a 35-year-old female who developed a hemiplegia following lavage through the natural ostium and injection of air into the antrum The patient remained unconscious for four weeks and then gradually improved and eventually recovered Goldenburg,[12] in discussing Cavanaugh's paper, mentioned a case of a 35-year-old female who died an hour after a puncture of the antrum and the insufflation of air under pressure An autopsy revealed an air embolism in the heart, and in the coronary, cerebral and mesenteric vessels Lebensohn,[13] also in discussing Cavanaugh's paper, knew of one case where even the air in the tube connecting a Lichwicz needle with a pint piston syringe was sufficient to cause a temporary hemiplegia from which the patient recovered in a few hours

McGovern,[14] in 1941, reported two cases with one fatality The first case, a 24-year-old Negro male, had a puncture of the antrum through the inferior meatus After the injection of air into the antrum he became unconscious, developed severe convulsions and died An autopsy was not performed In the second case, a 24-year-old white female with diabetes had the antrum lavaged through the natural ostium Upon the inflation of air, she became unconscious, and had severe convulsions She subsequently recovered in one week

Bashir, Taneja and Shah,[15] in 1945 described a case of cerebral embolism following the puncture of the antrum and the injection of air The patient collapsed, developed convulsions and paralysis, but subsequently recovered completely

Cornfield and Laszlo,[16] in 1949, reported a death following antral puncture and the insufflation of air The patient, a 46-year-old white male, collapsed and was seized with generalized convulsions, ceased breathing and died in spite of artificial respiration, and cardiac and respiratory stimulants given intravenously and into the heart An autopsy performed six hours later revealed a markedly distended heart and vena cava. There was a loud audible release of air when the heart was opened No air was found in the cerebral vessels The cause of death was reported as due to a massive air embolism.

F J Pinkerton,[17] of Honolulu, has had two fatal cases in his experience. In the first case, a male had a large polyp which protruded from the antrum and a purulent maxillary sinusitis The polyp was removed Three weeks later, a lavage of the antrum was done through the natural ostium The cannula was introduced without difficulty, in fact the cannula "practically fell in" as the operation had left the ostium wide open. During the lavage with the fluid, there was some blood Upon the insufflaton of air the patient fell unconscious, had a convulsive seizure and died within 20 minutes An autopsy revealed air embolism Pinkerton feels that in this case, the lavage may have loosened a few blood clots and left open the ends of a few blood vessels for the entrance of the air In the second case, a male with purulent maxillary sinusitis had repeated lavages through the natural ostium for a purulent infection In what was supposed to be his last lavage, he fell unconscious after the lavage and the insufflation of air had convulsions and died within half an hour An autopsy revealed air embolism

Kelley[18] reported an interesting case of a woman on whom he performed a puncture of the antrum through the inferior meatus On insufflation of air, a low gurgling sound was heard unmistakenly passing down the neck. The patient stated that she felt something passing down the neck but was in no way affected by it Kelley felt that the needle must have passed through both walls of the antrum and opened up a vessel in the pterygoid plexus of veins in the pterygomaxillary fossa and thus air entered into the circulatin

There is no doubt regarding the manner of development of air embolism The air must get into the circulation in only one way and that is, during the puncture a vessel must be punctured or injured and the air is forced directly into the circulation

Gurlitz[19] has shown that the antral mucosa is very vascular and in 50 per cent of his injected specimens there was a thick venous plexus over the antral wall or orbital wall, or over both walls, that whenever this plexus is present it is usually where it can be easily injured by the puncture Gurlitz's specimens were those of normal sinuses, moreover, in the infected maxillary sinuses where the antral mucosa is thickened and congested and frequently almost fills the maxillary antrum with loose edematous folds, one would expect to find an increase in the number of blood vessels

Gording[5] has studied very carefully the mechanism of the development of air embolism According to him, if the needle is advanced at a slow rate through a thick wall of the inferior meatus, the mucous membrane may be detached over a considerable area, that the blood vessels may be torn in these cases, the air is forced into the torn blood vessels and air embolism results In Bowen's[3] case, the mucosa of the roof, except for a small part as well as the outer and inner walls, was found detached as a result of a puncture through the mucous membrane of the roof and the forcing of air between the bone and the mucous membrane

After the air has entered the vein, it then proceeds from there to the right chamber of the heart From here, opinions in regard to the cause of death differ greatly Some consider that it is a "lung death" and believe that the air is driven from the right chamber of the heart into the lung capillaries which are embolized and the circulation is interrupted, with death as a result Most writers are inclined to the view that the cause of death should be looked for in a paralysis of the heart and it should be regarded as a "heart death" In many cases, the predominant symptoms are nervous disturbances Some workers assume that the air bubbles have passed through the lesser circulation and entered the arterial system, where they caused, through emboli of the brain vessels and medulla oblongata, the periods of unconsciousness, the convulsions and respiratory disturbances, thereby causing a "brain death"

Bergstrand,[20] basing his opinion on his rabbit experiments and clinical observations, felt that the danger with venous air embolism is from a drop in the arterial pressure as the accumulating bubbles of air reach the pulmonary capillaries The slowing of the current raises the pressure in the aortic vessels. This causes an anemia of the brain with neurological symptoms and death He found that paresis, indicating a local injury of the brain, was never noted in the animals or in clinical cases. The blood in the aorta is a dark color, indicating a defective oxygenation, hence inhalation of oxygen seems a rational treatment. Also, by lowering the head the negative hydrostatic pressure of the veins tends to prevent any inflow of air Even after the low pressure has been combatted, the danger is not past as the air accumulates in the right heart. He has never witnessed any benefit from a puncture of the right ventricle in the animals as the air escapes into the pulmonary artery and is not released by puncture. Venesection may give relief with any form of air embolism With arterial air embolism he found that the air enters the left ventricle and passes immediately into the aorta and bubbles are found in the peripheral arteries especially at the base of the brain. He also witnessed the presence of air bubbles in the choroidal vessels of the eye until they were gradually absorbed or swept along He estimated that 75 to 100 cc of air can be borne in a venous embolism without permanent harm, but even 1 cc of air in the artery is sufficient to kill a horse. It must be assumed, then, that in the cases of severe nervous manifestations and of death, the air must enter the arterial circulation It has been proven not only that air in the arterial system passes without difficulty through the lung capillaries but also that air bubbles in the venous circulation may be carried into the arterial circulation

Grove himself, felt that the nervous manifestations would arise during antral inflation if the air pumped into the circulation was insufficient to fill the right heart completely and stop its action suddenly The air would then be forced through the lungs and into the left heart and the greater circulation By passing into the vessels of the brain and the medulla, it would cause symptoms until it was absorbed

Kelley[18] has called attention to the fact that the grave symptoms which arise from the puncture of the antrum and the insufflation of air are strikingly similar to those which occasionally arise during the production of an artificial pneumothorax

The symptoms of air embolism are characteristic and once seen are unforgettable The onset occurs with dramatic suddenness and the patient usually slumps in the chair and becomes rigid and unconscious The unconsciousness is associated with pulse and respiratory changes, cyanosis and then convulsions The respirations may be irregular, stertorous, suspended and jerky, with periods of apnea There may be tonic and clonic contractions of various groups of muscles almost akin to an epileptiform seizure A severe trismus has been noted in several cases The pupils may become fixed and dilated, or there may be a nystagmus, conjugate deviation of the eyes, or a backward rolling of the eyeballs The pulse may be bounding, irregular, rapid or it may even be slow There often is an associated cyanosis or an ashy gray color As a rule, there is an elevation of the temperature Death may ensue immediately or may occur hours or days later Those that survive the initial onset may have transient disturbances of vision, alternating periods of blindness, varying degrees of paresis, paralysis and even hemiplegia, a feeling of fear and suppression, disorientation, mental lapses and other mental symptoms

Grove[1] reported six cases in which the common symptom was a transitory blindness Caesar Hirsch[6] feels that in the cases where visual disturbances exist, the air emboli are visible by immediate ophthalmoscopic examination and are recognized by the pallor of the disc, silvery, narrow arteries with air bubbles within their lumina, normal veins and a slightly clouded eyeground In his case of the 16-year-old girl mentioned earlier, he was able to see the bubbles of air in the retinal arteries

The signs and symptoms of air embolism are so characteristic that once seen they are unforgettable The only condition that may possibly confuse the diagnosis is a severe cocaine reaction In the milder cocaine reactions, there may be a feeling of anxiety, giddiness and fear, motor restlessness, headache, vertigo, hallucinations, extreme pallor and paresthesia The pulse is accelerated, and the patient may experience palpitation The pupils are dilated, and there may be nausea and vomiting In the severe reactions, there is a dilatation of the pupils, dryness of the mucous membrane, vomiting and clouded sensorium There may be epileptiform convulsive seizures that may be brief or more lasting Circulatory and respiratory depression may follow and manifest itself by a feeble pulse, slower and irregular respiration, and cold and clammy skin, Cheyne-Stokes respiration and finally collapse and coma may then occur Death usually results from a paralysis of the vasomotor and respiratory center of the medulla

Thus it can be seen that only the most severe cocaine reactions may cause a confusion in the diagnosis Most of the cocaine reactions are preceded by the premonitory symptoms mentioned above, while in the air embolism the onset is dramatic and sudden The other and most important point is that an air embolism always follows and never precedes air insufflation.

Attempts have been made to determine the frequency of air embolism in relation to the method of lavage of the antrum Air embolism may follow any one of the three methods of antral irrigation. In Grove's death series of 15 cases a puncture was done through the inferior meatus in seven cases through the middle meatus in three cases and in five cases the route was not mentioned. In the next 22 cases, with symptoms very similar to the death cases there were 12 punctures through the inferior meatus, two from the middle meatus, and in eight the route was not mentioned In the six cases of transitory blindness, two followed puncture through the inferior meatus, three from a puncture through the middle meatus, and in one case the route was not mentioned The cases of Coffey, Meunzer and Lanier, that were mentioned by Grove, all followed an inferior meatal puncture

In Bacher's case, the lavage was done through an inferior meatus puncture Cavanaugh's case followed an irrigation through the natural ostium, while Goldenberg's and Lebensohn's cases were through the inferior meatus In McGovern's two cases, one followed lavage through the natural ostium while the other followed a puncture through the inferior meatus The case reported by Bashir, Taneja and Shah resulted from an inferior meatal puncture, as was the case of Cornfield and Laszlo Pinkerton's two cases followed a lavage through the natural ostium, as did my two cases

From this series of 58 cases, 30 followed a puncture through the inferior meatus, 14 from the middle meatus, six from the natural ostium, while in eight cases the route was not mentioned, thus it would seem that this complication is more frequent following a puncture through the inferior meatus Anatomically, this would seem to be borne out by Gerlach's anatomical study which showed that there is a large plexus of veins in the medial wall of the antrum in the region of the points of entrance of the trocar, however, despite these facts, the seeming predominance in the incidence of air embolism following a puncture of the inferior meatus may be due to the fact that this is the route most often used[26]

Nothing much has been written regarding the treatment of this condition From all indications, the treatment does not seem to influence the outcome and is entirely symptomatic Artificial respiration and respiratory stimulants should be given if the respirations stop and circulatory stimulants for cardiac arrest The inhalation of oxygen is a rational treatment in view of Bergstrand's experimental and clinical findings of a general anemia of the brain resulting from a drop in the aortic pressure and the resulting defective oxygenation Also by lowering of the head, the negative hydrostatic pressure may tend to prevent any inflow of air

Bergstrand also mentions the use of venesection In his rabbit experiments, he had never noticed any benefit from a puncture of the right ventricle

The prognosis of air embolism is serious In general, it depends upon the amount of air and the rapidity with which it is pumped into the circulation as to whether the patient is going to die or recover It also depends upon the organ that is involved In the 58 cases that I have collected, there were 23 deaths with a resulting mortality of 39 5 per cent. McGovern states that the mortality varies from 15 to 50 per cent and that the patient surviving the first 15 minutes has a better prognosis Just how or where he derived these figures is not mentioned in his article

In many of the cases air embolism was demonstrated at autopsy Air has been found in the cerebral vessels, the mesenteric vessels, the pulmonary artery the juguler veins and in the lungs In a few cases, the right heart was found distended with dilated pulmonary arteries and hissing of air was heard on the opening of the heart and pulmonary veins, however, in many cases, the presence of air was not demonstrated. Grove feels that even in those cases of death in which no air was found in the circulation on autopsy an air embolism which was overlooked might have been present in the coronary arteries or in the vessels of the brain It is easy for pathologists to overlook this factor, for few of them think of opening these organs under pressure unless the clinician specifically requests it.

How can we prevent air embolism following a lavage of the antrum? This is a most important question in view of the severity of this condition Although air embolism is supposed to be relatively rare, it probably is more frequent than is reported because many surgeons are either loathe to report their bad cases or are too busy and lack the time and energy to do so, furthermore, it could be that many cases of air embolism were probably diagnosed as cocaine reactions In my opinion the only sure way of preventing this complication is to discontinue entirely the insufflation of air into the maxillary sinuses

It was formerly the practice of the older otolaryngologists to insufflate air into the antrum before irrigation and again after irrigation to dry out the sinus This practice of insufflating air before the irrigation to determine whether the point of the needle is in the sinus and whether the ostium is patent, is entirely unnecessary If the point of the trocar or cannula is within the sinus, it should be freely movable and there should be no pain or resistance during irrigation If the point of the needle has passed through the nasal and lateral walls of the sinus from the inferior meatus or through the nasal and orbital walls from the middle meatus, its shaft will not be movable At any rate, should there be any doubt about the correct position of the needle, a small syringe may be used first to withdraw air, pus or mucopus from the sinus before irrigating the field

It is also unnecessary to dry out the sinus after irrigation, because there is absolutely no harm in leaving a small amount of saline solution, boric acid or any other mildly antiseptic solution in the antra after the gross products of infection have been removed Normal saline in itself is stimulating to the cilia and any irrigating fluid is rapidly emptied by the ciliary action or by changing the position of the head or by blowing the nose

There seems to be little or no disagreement among modern day otolaryngologists regarding the insufflation of air into the antrum prior to the irrigating fluid This practice has been discarded by nearly all otolaryngologists and has been discouraged by all textbooks and the postgraduate schools of otolaryngology, however, there still is a disagreement regarding the question of inflation of air into the antrum after the irrigating fluid In a review of the textbooks of otolaryngology, it is seen that most authors advise against this practice Hajek,[2] Morrison,[21] Turner,[22] Lederer[23] and Neivert[24] warn of the danger of air embolism Lederer further advises the evacuation by suction and then irrigation with normal saline followed by suction evacuation again Phillips[25] and Van Alyea[26] advise the use of air after irrigation Van Alyea states that, "Inflation following irrigation removes the residue to the solution and helps to promote early restoration of function The dangers associated with inflation are contingent upon the presence of the cannula tip in the nasal or sinus mucosa This is not likely to be the case if the sinus has just been irrigated and its contents removed When a return flow has been established one may be sure the tip is not imbedded in the membrane The injection of air preceding lavage, when there is some doubt as to the exact location of the tip accomplishes nothing and may carry with it some element of danger Its use should be discouraged as hazardous and worthless procedure"

There is also a difference of opinion regarding this point in the teachings of the various medical schools which conduct a graudate course in otolaryngology Schools which teach their students to inflate the sinuses after the irrigating fluid include the University of Pennsylvania,[27] Washington University of St. Louis[28] and New York University[29] Schools that advise against the inflation of air include Northwestern University,[30] Harvard University[31] and Tulane University[32]

Personally, having had two unfortunate experiences I am strongly opposed to the inflation of air into the antrum especially since I can see no advantage in doing so During our training and residency days, we were taught to lavage the antrum with normal saline, using an irrigating bottle connected with compressed air It is quite possible for air to escape before the fluid or to be mingled with the fluid I am sure that this was the cause of the mishap in my first case Right or wrong, I have discarded the use of an irrigating bottle and compressed air and have substituted the use of a Pitkin Sana Lok Syringe In using this syringe great care is taken to see that all the air is emptied from the syringe and the connecting tube before any solution is injected into the antrum, furthermore the nurse who manipulates the syringe is trained to report the least bit of pressure felt while injecting the irrigating fluid

Pinkerton feels that if any air is to be insufflated one should be very careful in the recent postsurgical case as the ends of the small blood vessels may still be open and predispose to an air embolism Again, why inject any air at all?

The following is a report of two cases of air embolism that have happened in my practice

Case 1 A. L a 25 year old Chinese male, was first seen on March 1, 1940, with the complaint of nasal obstruction, a purulent nasal discharge and rheumatic pains in the joints An otolaryngological examination revealed a large septal spur on the left side which was jammed up against the left middle meatus a polypoid degeneration of the posterior tip of the left inferior turbinate and pus in the left middle meatus and nasopharynx A submucous resection of the nasal septum was done on April 13, 1940 Subsequent to this he reported periodically for treatment and complained of a continued nasal discharge On May 21, 1940, a lavage of the left antrum was done through the natural ostium. During the lavage, it was noticed that air was also escaping from the irrigating bottle together with the nomal saline Suddenly the patient collapsed in the chair, had a carpopedal spasm followed by generalized clonic convulsions, the pulse was rapid but of good quality, and the respirations were jerky and irregular The pupils were small and reacted to light Between convulsive seizures the patient appeared flaccid After an hour it was decided that this was more than the usual "fainting spell' and the patient was sent to the hospital in an ambulance While being carried down the steps on a stretcher he had a severe convulsion dropped from the stretcher and landed head first on the concrete floor from a level of 12 feet suffering a laceration of his scalp in the region of the right occipitoparietal area

On admission to the hospital, the blood presure was 124/90, the temperature 102 4° F, rectally, the pulse 140/min and the respiration varied between 32 to 40/min R B C, 6,150 000 with 90 per cent hemoglobin, W B C, 21,400 with 90 per cent polys Urinalysis normal X ray of the skull was negative for a fracture

A neurosurgeon was called into consultation and his notes were as follows 'The patient is semiconscious and will respond to commands Lies with his eyes open, staring and expressionless Any attempt to move him causes him to kick violently with his right leg Respirations are quiet and regular Occasionally he spits out saliva forcefully, swallows, but keeps mouth tightly closed Fundi normal Pupils widely dilated and fixed to light There is a constant oscillating conjugate movement of the eyes upward and to the left, a type of nystagmoid movements with the quick component toward the midline This movement is at times a wide excursion and at other times a narrow one Corneal reflexes are present with the left side more active than the right He moves all extremities except the right arm which is moved reluctantly The right leg, however is almost constantly kicking, elicited by movement of the arms and legs The movement of the extremities cause extreme extensor rigidity arms extended and pronated, fingers over thumbs No flaccidity The biceps, triceps, radical reflexes, knee jerks and ankle clonus are slightly hyperactive The plantar reflexes are diminished and the abdominal reflexes are absent *Impression* 1 Possible extradural hemorrhage from skull fracture 2 Intracortical hemorrhage—spontaneous '

A spinal puncture revealed normal pressure, the fluid was a pinkish yellow with floating red cells Microscopic examination showed five leucocytes per c mm and numerous blood cells

The patient continued comatose in fact, the coma deepened and he had two projectile vomiting spells. He had typical Jacksonian convulsions starting from the left fingers and wrist and gradually extending to the left side of the body During these seizures the eyes deviated to the right. After six of these convulsive seizures which occurred at short intervals, it was decided that there probably was an irritative focus on the left side probably in the motor areas The convulsions were not controlled by sodium luminal, so one-half gr of morphine sulphate was given subcutaneously Within an hour the respirations became depressed he ceased breathing for several minutes but commenced to breathe again after the administration of artificial respiration He was rushed to surgery during which time artificial respirations had to be continued in order to keep him alive A right temporoparietal craniotomy was done The brain was found to be under great tension and herniated considerably On aspiration of the fluid from the frontal horn of the left ventricle the fluid appeared to be under great pressure After aspiration the patient's respiration improved and he breathed 12 to 14 times per minute by his own effort. No evidence of any cortical hemorrhage was seen. A large subtemporal decompression was made in the lower portion of the bone flap He was given several blood transfusions and was returned to the ward in fairly good condition.

Postoperatively his respirations were free and easy and his temperature, though lower than at surgery continued at 102° and 103° F His condition was considered satisfactory but on the second postoperaive day he suddenly became cyanotic and expired in spite of all treatments.

An autopsy revealed cerebral congestion and edema cerebral extravascular hemorrhage of the left temporal lobe and the left motor cortex pulmonary congestion diffuse toxic hepatitis cloudy swelling of the kidneys and subendocardial hemorrhage.

Case 2 P L., a 40-year-old Chinese male was seen at periodic intervals for a right maxillary sinusitis. He was in good health except for the recurrent attacks of sinusitis. He had had a previous submucous resection of the nasal septum and numerous lavages of the antrum both through the inferior meatus and through the natural ostium, without incident. On July 20 1945 a lavage of the right antrum was done through the natural ostium and air was insufflated to dry out the antrum. Suddenly the patient gave a grunt, stiffened up and fell over backward in the chair unconscious and stopped breathing He was immediately placed on the floor artificial respiration was started and 1 cc. of adrenalin chloride 1 1,000 was injected intravenously After his respiration returned it was sterterous and irregular and there was much foaming of the mouth. There was an alternating spasm and relaxation of the muscles of his extremities and a severe trismus. The pulse was rapid but of good quality He was cold and clammy with a profuse perspiration. The pupils were small and reacted to light but there was a conjugate deviation to the left. The patient was hospitalized and a neurosurgeon was called into consultation

On admission to the hospital the temperature was 98.3° F the blood pressure 130/80 pulse 120 and the respiration varied between 20 to 30 per minute He was given oxygen through a nasal catheter the foot of the bed was elevated penicillin was given intramuscularly and caffeine sodium benzoate when necessary He continued in coma and his temperature rose to 103° F The convulsions continued and there was a marked extensor spasm of all four extremities intermittently with a clock-like decerebrate rigidity Between attacks of spasms the extremi ties were flaccid and there was a bilateral ankle clonus The pupils became dilated but reacted to light, and there was a continued conjugate deviation to the left The patient's condition became worse, with a gradual climbing of the temperature, a more irregular respiration until there was a Cheyne Stokes respiration The stomach became markedly distended, and a Wagenstein suction bottle was used to attempt to control the gastric dilation The tracheobronchial tree began rapidly to fill up with mucus, so an attempt was made to aspirate the trachea As this was being done, the patient developed a reverse peristalsis and vomited up an enormous quantity of dirty black material and ceased breathing

At autopsy, there was edema of all the lobes of the lungs and patchy areas of consolidation of both lower lobes The trachea and primary bronchi contained a small amount of clotted blood The heart appeared normal but was not opened under water The stomach was markedly dilated and contained much dark, thready material which had the appearance of old blood The rest of the gastrointestinal tract was normal The left maxillary sinus revealed a purulent infection and a small polyp Sections through the brain showed purplish gray discolored areas at the level of the optic chasm, the anterior end of the third ventricle, at the tip of the globus pallida on the left side and the lower part of the midpons The area in the midpons was 1 cm in diameter and appeared to encroach upon the pyrimidal tract. There was no gross lesion to be seen such as hemorrhages, softening or massive air embolism

Comment In the first case, the picture was complicated by the unfortunate fall, however, the clinical picture before the fall was typical and characteristic of an air embolism The findings at autopsy were complicated and were overshadowed by the cerebral edema subsequent to the injury and the surgical procedure

In the second case, the symptoms also were characteristic and typical of an air embolism, although no air embolism was found At autopsy, however, the heart and pulmonary artery were not opened under water

SUMMARY

1 The most serious and alarming complication of a lavage of the maxillary sinus is an air embolism

2 A review of the literature is presented Fifty-eight cases of air embolism have been collected Of these 58 cases, there were 23 deaths with a resulting mortality of 39 5 per cent

3 The signs and symptoms of air embolism are characteristic and once seen are unforgettable

4 Two cases of air embolism following the lavage of the antrum and the insufflation of air are presented

CONCLUSIONS

1 The inflation of air following a lavage of the maxillary sinus is not only unnecessary but exceedingly dangerous

2 The only way to prevent this complication is to avoid the insufflation of air into the antrum

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BRONCHIAL ADENOMA.*

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Sixty nine years ago Mueller[1] reported the first bronchial adenoma At necropsy on a woman who died from suppurative lung disease of eight years' duration, he found a pedunculated adenoma partially occluding the left main bronchus

In 1927 Heine[2] found a polypoid tumor the size of a grape in the right middle lobe bronchus of a 45 year-old woman. It had given rise to no symptoms, although bronchiectasis was noted distally to the tumor

A year later, Reisner[3] reported the death of a woman from empyema and bronchial obstruction This obstruction was due to an adenoma. In 46 years only three cases of bronchial adenoma were reported, and all were diagnosed at necropsy

Since the last report in 1928 many excellent articles relating to the various aspects of bronchial adenomas have appeared. Prior to 1944 were the reports of Womack and Graham,[4] Brun and Goldman,[5] Foster-Carter,[6] Goldman and Stephens,[7] Anderson,[8] Adams *et al.*,[24] Laff and Neubuerger,[9] and Riordan and Richards.[10] Since 1944 are those of Jackson, Konzelmann and Norris,[11] Nager[12] Graham and Womack[13] Chamberlain and Gordon,[14] Harris,[15] Clerf,[16] Souders and Kingsley,[17] Moersch and McDonald,[18] Maier and Fischer,[19] McCart,[21] Holley,[23] and Huizinga and Iwema.[27] In all, about 300 cases have been tabulated, nearly all of which were diagnosed antemortem.

Almost all early writers stressed the benignancy of these growths although Kramer[20] in 1930 suggested that local ma lignancy might occur It would seem that adequate evidence is now available to merit a definite conclusion relative to the classification and treatment of this interesting neoplasm

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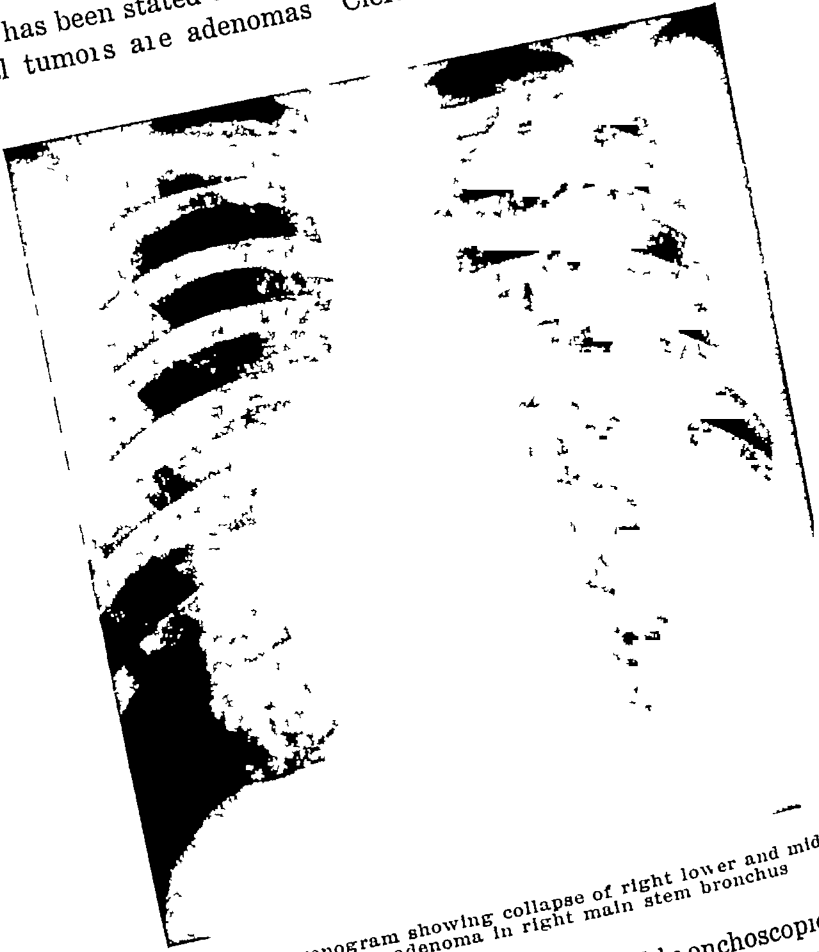
It has been stated that about 8 per cent of all primary bronchial tumors are adenomas Cleif reported an incidence of



Case 1 Roentgenogram showing collapse of right lower and middle lobes which was secondary to adenoma in right main stem bronchus

12 per cent of 278 neoplasms diagnosed bronchoscopically Of 217 histologically proven primary lung tumors diagnosed at the Lahey Clinic since 1930, the incidence was 6 9 per cent, or only 15 adenomas They reported nine of the cases within

the past three years, compared with six in the previous 15 years. This may indicate a more definite agreement on the histology

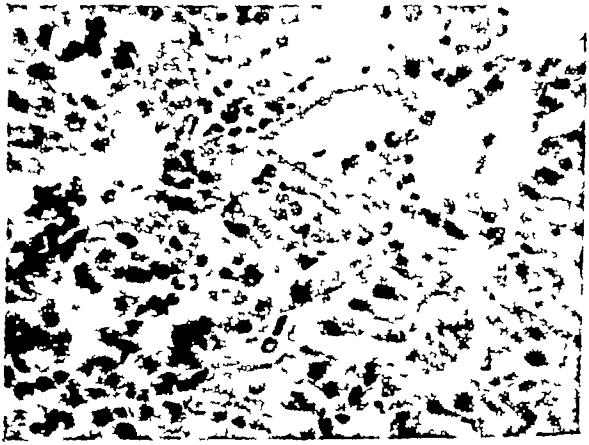
Bronchial adenomas are more prevalent in the third and fourth decades They are somewhat more prevalent in females

Case 1. Roentgenogram taken two years after right pneumonectomy for adenoma.

The tumor is usually located in the larger bronchi, hence readily visualized bronchoscopically, however, Maier and Fischer[19] have reported adenomas arising in small bronchi and not visible bronchoscopically

One of the chief characteristics of the symptomatology of these growths is chronicity Bronchial adenoma is a slow-growing tumor, hence has prolonged signs Cough, wheeze and blood-tinged sputum may be the only symptoms for many months or even years, however, recurring bouts of fever and chest discomfort frequently diagnosed as atypical pneumonia by the clinicians and unresolved pneumonia by the Roentgenologists should arouse one's suspicion of an endobronchial new growth and be followed by a request for bronchoscopic examination Further variations of symptoms depend on the endo- and peribronchial extension of the growth and the resulting mechanical conditions

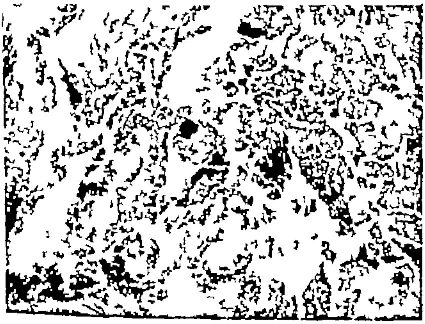
Two new cases are herein reported to further emphasize the protean nature the symptoms may present These two cases had similar operative findings but very dissimilar preoperative histories



Case 1 Photomicrograph showing glandular formation with incomplete lumen

Case 1 A young man, aged 20, had six endoscopic treatments in five years of an adenoma in the right main bronchus The tumor eventually became obstructive,atelectasis developed and operation was necessary At operation extensive hilar spread was found and a pneumonectomy was indicated Only four years have elapsed but he is in excellent physical condition He is an instructor in a college of music, sings in the glee club and plays a wind instrument in the orchestra Diagnosis was bronchial adenoma, carcinoid type

Case 2 Mrs H., age 32 no chest symptoms until six months before surgical treatment was instituted. Within one month she had two bouts of chills fever and lower right chest discomfort. The diagnosis was atypical pneumonia. Roentgen diagnosis was unresolved pneumonia with question of a small area of segmental atelectasis of the right lower lobe At bronchoscopy a small reddish new growth was seen in the bronchus of the posterior basal segment on the right side Pathological diagnosis was bronchial adenoma, cylindroma type Surgery revealed extensive peribronchial spread upward along the main stem necessitating removal of the lower and middle lobes The patient is well and asymptomatic after three years.



Case 2. Photomicrograph shows cylindroma type of cells with amyloid stroma.

It is interesting to note the various names used in the past to describe these tumors

1931 — Geipel — Basal Cell Cancer

1932 — Wessler and Rabin — Benign Bronchial Adenoma.

1935 — Kiernan — Carcinoid

1935 — Moersch and Bowing — Adenocarcinoma.

1936 — Clerf and Crawford — Benign Glandular Tumor

1937 — Zamora and Schuster — Vascular Adenoma

1937 — Welt and Weinstein — Endothelioma.

1937 — Hamperl — Cylindroma and Carcinoid.

1938 — Womack and Graham — Mixed Tumor of the Lung

1940 — Achsner — Reserve Cell Tumor

1940 — Goldman — Polypoid Bronchial Tumor

The type of cell is essentially the same in all bronchial adenomas, but there are distinct variations in the arrangement of cells which enable the tumors to be classified into two histological groups

1 Consists of tubular and glandular alveoli

2 Atypical structure and less degree of glandular formation, together with solid acini and irregular masses of cells Mitoses are seldom seen These variations in structure have caused confusion in the past and failure to recognize them has falsified diagnosis

The most commonly used terms are Carcinoid and Cylindroma or Mixed Tumor A large majority now reported are called Carcinoids Pearson and Fitzgerald[22] state that all carcinoid tumors should be considered malignant Argentaffine granules have been definitely demonstrated in only one bronchial adenoma (Holley[23]) This would indicate these bronchial tumors are not histologically identical with the carcinoids of the alimentary tract There is a striking histologic similarity between bronchial carcinoids and the islet cell tumors of the pancreas[9] Boyd[26] also noted a likeness between pancreatic islet cell tumors and carcinoids of the appendix

According to Ewing[24] the term cylindroma may be used to designate any tumor in which the stroma appears in the form of elongated, twisted, thickened cords of hyaline substance The term should be used only as descriptive and not implying any fundamental relation to the cylindromatous type of basal cell carcinoma

The mixed tumor classification as suggested by Graham and Womack[13] is further supported by Holley[23] in his report of 39 cases of bronchial adenomas Thirty-four were classed as carcinoid and five as mixed tumor, however, to add to the confusion, he states that the stroma in these five cases was not of the myxomatous, osteoid or cartilaginous type usually associated with mixed tumors. To this extent the term mixed tumor is a misnomer

The widest divergence of opinion occurs concerning these so-called mixed tumors or cylindromas They have been considered as a bronchial tumor apart from the adenoma They have a very close resemblance to the mixed tumor of the salivary glands and to basal cell carcinomas of the skin Ewing[24] states that a marked similarity also frequently occurs between mixed tumors of the salivary glands and basal cell skin carcinomas.

Obviously the exact classification of these bronchial tumors is not yet determined. The relationship of these adenomas and alimentary carcinoids, pancreatic islet cell tumors, basal cell carcinomas of the skin and certain tumors of the salivary glands remains to be explained

The malignant potentialities of bronchial adenomas offer an important problem There has been a marked lack of agreement on this point, hence no uniformity of therapy Such authorities as Foster Carter[9] and Clerf[16] state that metastases do not occur and doubt if the tumors ever become malignant. Recently there have been several unequivocal reports of metastases. Anderson[8] reported metastasis to the liver Laff and Neubuerger[9] reported an adenoma with cylindromatous features which metastasized to the opposite lung

Adams *et al.*[25] presented five malignant bronchial adenomas. Moersch and McDonald[18] also reported five cases of definitely proved metastases They noted that metastasis to the liver is followed by rapid development of hepatic insufficiency and death. Holley[23] reports two metastases to hilar lymph nodes and one to the liver Metastases have appeared in the liver, bone, thyroid gland, skin contralateral lung and regional lymph nodes

SUMMARY AND CONCLUSIONS

Bronchial adenoma is a potentially malignant tumor The malignancy is low grade.

Most of the tumors occur in the larger bronchi Mucous glands are present in bronchi 2 mm in diameter, hence adenomas may occur in these smaller branches and not be visible bronchoscopically

The tumors usually have an intact mucosa, which explains why cytologic study of bronchial secretions often gives negative results

Exact histological classification has not been determined Carcinoid and cylindroma (mixed tumor) are now the commonly used terms

About 90 per cent of the cases can be diagnosed bronchoscopically, however, no one has presented histologic criteria by which, on biopsy, it can be predicted how much of the tumor is within the bronchial lumen or to what extent invasion or distal spread has occurred

In suitable cases the most satisfactory results are obtained by surgical extirpation of the lesion It may require bronchotomy, lobectomy or pneumonectomy Patients of advanced years and those with the tumor at the carina may have to be treated endoscopically A definitely pedunculated tumor may be removed by bronchoscopic means but the "iceberg" nature of these neoplasms must always be considered What is seen may be only a small portion of a peribronchial involvement Body section Roentgenography may be of valuable assistance

Patients treated endoscopically must be re-examined repeatedly because of the tendency to recurrence Severe hemorrhage may follow bronchoscopic removal and stenosis follow repeated coagulations

The exact rôle of deep Roentgen therapy is not determined

Even though many of these tumors do not fulfill our commonly accepted criteria for malignancy, their conduct is of such a malignant nature that total extirpation is the best form of treatment

Two cases are reported which demonstrate this type of conduct one of five years' duration and one of less than one year

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A NEW DESIGN FOR A RONGEUR TO BE USED IN LOWERING THE BONY SEPTUM *

ALBERT P SELTZER, M D ,
Philadelphia, Pa.

The removal of the nasal hump is one of the successes of plastic surgery which is frequently practiced, and the technique of this operation is familiar to all plastic surgeons [1] The intranasal incision is made, and the overlying skin of the region is undermined, followed by elevating the periosteum over the parts to be removed The excess tissue forming the hump is removed by cutting completely through at the desired level. The maxillary processes are fractured or separated by use of a saw in order to allow their closer approximation over the bridge, to narrow the nose sufficiently

When this last step is carried out, there is no need for recourse to the rules of geometry, to realize that pressing the maxillary processes toward the median line changes their relation to the perpendicular plate of the ethmoid, which forms the bony septum The result is that the upper border of the septum forms a sharp ridge along the nasal dorsum in this region. The final result is that a dorsal line is created, which is covered by only a thin layer of skin This condition lends itself easily to injury, by its tendency to act as a cutting edge Thus the skin may be cut through by the bony ridge leading to scar formation and more or less disfigurement

Kazanjian[2] has devised a rongeur with which he removes the entire hump, without the use of the saw In the hands of the writer this method has not proved so efficient as the customary one, in which the hump is excised by using the saw After the removal of the bony fragment, the remaining bony septum has usually been lowered by means of a rasp

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From the Department of Plastic and Reconstructive Surgery St. Luke's Medical Center Philadelphia, Pa.

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or a common rongeur The use of these instruments often leaves a rough, bony edge to form the dorsal line over the bridge

To avoid this outcome of the operation, the writer has prepared a rongeur, with which the perpendicular plate can be lowered evenly and smoothly

This instrument (see Fig 1) is made of stainless steel, and is seven and one-eighth inches (20 5 cm) in length The

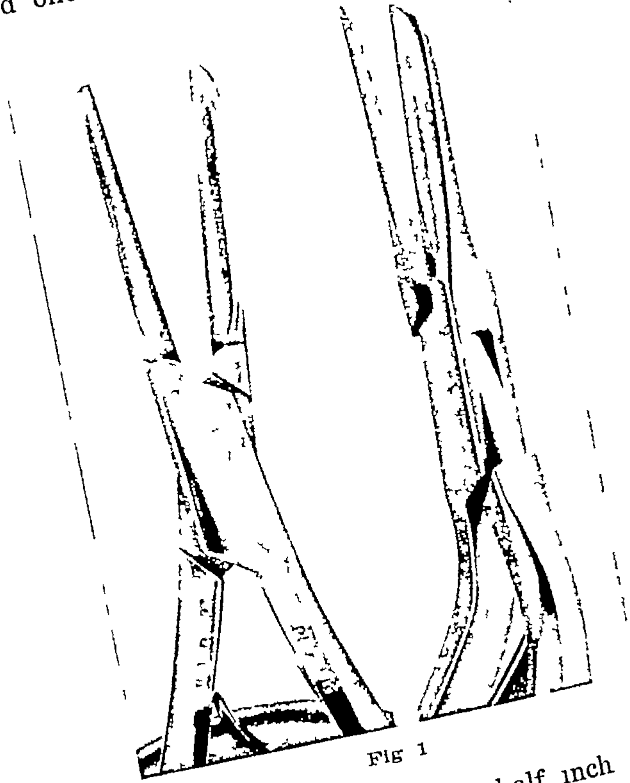

Fig 1

measurements at the hinge are one-half inch (1 2 cm) by five-sixteenth inch (1 0 cm) The blades are two inches (5 0 cm) in length They are beveled and are relatively thin To allow for reaching the bony septum, they are canted to form an angle of 90 degrees between their upper surfaces The handles (shanks) are angulated to an obtuse degree, just behind the hinge, and are cross hatched to provide a firm grip (see Fig 2)

The special value of this instrument is that after the hump has been removed, the blades can be fitted between the cut edges of the maxillary processes, to lie on either side of the bony septum, and the necessary amount of tissue can be cut from the septum accurately and easily The anterior maxillary processes can then be pressed toward the median line, and the final presence of a roughened prominent dorsal ridge is avoided.

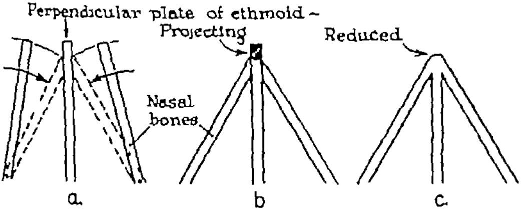

FIG 2.

The writer has found that the use of this rongeur offers a particular advantage for narrowing the bridge in the operation for removal of a nasal hump

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NUTRITION AND RELATED PROBLEMS

ISAAC H JONES, M D , Los Angeles,
EUGENE R LEWIS, M D , Los Angeles,
and
HAROLD S MUCKLESTON, M D , Pomona, Calif

Two decades ago came the great change in Otolaryngology Practice and interest and the literature had largely featured surgery Then came the sulfa drugs and then the antibiotics—and now our specialty is more in the medical than in the surgical field Hilger,[1] however, considers that our opportunity has been broadened and that the prophets of doom have not spelled the end of otolaryngology He feels that its scope is now enlarged by a closer integration of our field with general medicine — that the otolaryngologist has become more of a doctor and less a narrow and isolated specialist

Interest in nutrition is a symbol of this trend Likewise studies of the endocrines, autonomic influence, stress and allergy

To some nutrition simply means food, if, however, it is defined as the sum of all processes by which the body is nourished, or as the sum total of metabolic processes, both anabolic and catabolic, which result in the health or disease of tissues, or simply as 'what accounts for the health of tissue good or bad' — nutrition might actually be considered to include these other related subjects At any rate nutrition endocrines autonomic influence, stress and allergy are all

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interwoven inextricably in clinical practice. It seems to us that they not only overlap but often interlock — one dependent on the other. The understanding of one is certainly not clear without an understanding of the others. Each of these subjects is elaborately presented in the literature, *separately*, but one wonders if each might not be considered as a finger and all five might not be considered together, as the thumb and fingers of a hand. Into each one's practice comes a hint of this interrelationship and also the desire to master it. It is a consummation devoutly to be wished — although with such a vision comes the arresting thought that "if one does not aim beyond the stars he will not reach the stars."

Of all the problems in medicine is there no other that belongs with these "five fingers"? It would seem that the others, such as infection, neoplasm, trauma, heredity and congenital abnormality are not directly related to nutrition but are, so to speak, "on the other hand."

We find this idea helpful, not only with a patient whose symptoms have no obvious cause but particularly with those whose history and findings offer no clue whatever. We mention the five subjects and see if one or more of them may lead to something suggestive. At least it gives an approach to a problem, and in the discussion of these points the patient may reveal pertinent facts. For example, a woman has been greatly distressed, day after day for many weeks, by a feeling that she is about to pitch forward — never in any other direction. Vestibular findings normal in every detail. Cochleas normal. We then ask about nutrition and find that she has been studied at one of our best metabolic clinics for two weeks, with recommendation for increased protein. So that seems to be covered. Endocrines. Apparently negative. She had an uneventful menopause ten years ago without sequelae. Autonomic influence or allergy. Nothing in history or present state suggests either. Stress. For over a year she had worried greatly over her husband's incapacity to work — cause undetermined. This offered a possible lead toward an explanation and relief and the idea was discussed with the patient. Following the husband's recovery the symptom promptly faded away

Having offered some definitions of nutrition we will now consider some recently available data concerning the other four problems in an attempt to *correlate* them with nutrition as well as with each other

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When vitamins first came upon the stage they held the center for years, their importance is in no way lessened now that they have found their place. At the moment it is the adrenal cortex that has gained great prominence and like the vitamins, it is destined to maintain it. The unfolding story of the adrenal glands is presented by Mulholland[4] For nearly 100 years it has been known that these organs, though so small, are essential to life The modern story of the adrenal cortex began in 1930 when extracts became available for human use. The gland is concerned with the ability to exist in an environment which changes, its medulla provides epinephrin for sudden emergencies and its cortex provides the

many hormones for more profound environmental changes These hormones from the cortex affect the electrolyte balance and the metabolism of protein, carbohydrate and fat They have widespread effects in almost every metabolic process Hyperactivity of the adrenal cortex causes marked diminution of eosinophils The rate of their disappearance is fairly uniform, if 25 mg of ACTH is given the fall is maximal in 4 hours This is the basis of the Thorn test With a competent and responding adrenal cortex the fall is from 50-100 per cent of circulating eosinophils Sufficient evidence in the human being has accumulated to establish that the pituitary-adrenal cortex system is a protective buffer against environmental change

AUTONOMIC FUNCTION

Although he does not discriminate between functional variations and dysfunction Hilger[1] presents an ingenious interpretation The very term "vasomotor", so often applied to the nose or internal ear, implies a motor mechanism, this is neural and centers in the hypothalamus which controls the autonomic functions of all parts of the body It is influenced by the psychomotor areas in the frontal cortex and reflexly by body surface receptors There is evidence that the pituitary is influenced — if not controlled — by the hypothalamus It operates through the pituitary and hence through the blood, it also acts directly through neural pathways, to exercise direct cellular control in the peripheral tissues The sole purpose of the autonomic nervous system is to contribute to man's adaptation to environment Hilger's concept is that disordered function results when the hypothalamus is unequal to the task The environmental influences are, in the order of their importance, emotional, physical, inhalant and ingestant There first occurs arteriolar spasm, then ischemia, cell injuries and transudate It becomes increasingly apparent that mucoid middle ears may result less from bacteria than from tissue reactions In the bronchial tree neuromuscular activity may be added — asthma Neurovascular change can affect the internal ear — cochlear or vestibular Neural tissues tolerate ischemia poorly and lose function rapidly Although

Hilger may seem to overemphasize autonomic dysfunction to the exclusion of other important factors, his concepts are pertinent and stimulating In adapting his concept to the internal ear he[5] regards autonomic dysfunction as the prime factor in its many disturbances and endocrine imbalance as a frequent additional factor He considers that the clinical picture varies with the neural segment involved and the degree of involvement, that chronic progression suggests minute neurovascular changes whereas extensive angiospasm accounts for complete loss of cochlear and vestibular function He describes in detail the various medications which he used, the outcome in fourteen cases and his interpretations

Many cochlear disturbances suggest to Cook[6] a mild hydrops which he terms a "water-logged" ear The hearing fluctuates at times the ear feels clogged up and sounds seem discordant or too loud He finds this concept reasonable because in some the symptoms are transitory while in others they progress to deafness A water logged ear seems vulnerable to loud noises, he calls such persons "noise-susceptible" The majority of his patients were using salt in excess so he gave low sodium and high potassium intake for one month, if there was no response he added nicotinic acid as a vasodilator

STRESS

All who study the remarkable and elaborate work of Selye[7] may well be grateful to Guillemin[8] for presenting its main points. When any living organism is placed under abnormal conditions which disturb its vital equilibrium — in other words, under *stress* — the organism reacts against them The phenomena which result are termed the 'Alarm Reaction" It is a call to arms of the defenses of the body These reactions which constitute the resulting shock are practically identical regardless of the nature of the insult among other results, the experimental animal almost always develops gastric ulcer In the countershock which ensues epinephrin is immediately thrown out by the adrenal medulla then follows ACTH which causes the adrenal cortex to send out hormones of the cortisone type. This provides the organism with a much more prolonged defense than that from the epinephrin Also released are other endocrine substances not yet fully understood Now, if the stress ceases this fight ends and endocrine hyperactivity subsides On the contrary, if further stress is applied then the body must continue to defend itself against this abnormal condition to which it tries to *adapt* Soon the organism reaches what is called the *stage of resistance*, in which it has developed an *optimal adaptation* Now, if stress continues for several weeks, or even for several days if it is very strong, the defense mechanism collapses and the animal dies These three stages — alarm reaction, resistance and exhaustion — are termed the *general adaptation syndrome*

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ALLERGY

It is refreshing to have Semenov[10] recall that not long ago — and yet the time seems distant — all rhinitis and sinusitis was attributed to infection, words such as "histamine" and "allergy" were known only to research workers, and Sir William Osler called syphilis "the great imitator" As matters now stand, the great imitator seems to be allergy In any consideration of the pathology of the nose and sinuses we must reckon with allergy, not only its typical form such

as hay fever but also its masked form as in "collagen disease" Semenov notes that in some of these obscure conditions infection is the precipitating factor, but that the resulting storm rotates in allergy and often runs a relentless up and down course, which we fought for years under what he terms the "tattered and torn banner" of focal infection

The hope that hearing loss may be prevented or restored by judicious antiallergic treatment is offered by Jones and co-workers.[11] For years many have regarded allergy as one of the causes of impaired hearing As to the middle ear, the writers have observed permanent restoration of hearing by eliminating a common underlying cause of recurring nasal sinuitis, allergy Recently interest has centered upon the theory that Ménière's Syndrome is vasomotor in nature, due to autonomic dysfunction or allergy Helpful in treatment are elimination of contacts, a selection of foods which have minimal allergen content with maximal protein and complete nutritional values, and aid in the physical and mental rehabilitation of the patient.

Also in the experience of Shambaugh Jr[12] allergy may be a factor in deafness of both middle and internal ear types The tube and middle ear are lined with the same respiratory mucosa that readily elaborates antibodies against foreign proteins and often develops clinical allergies Allergy of the internal ear seems less easy to explain until we reflect that the endolymphatic tissues are derived from the ectoderm which also readily becomes sensitive to foreign proteins As in nasal allergy, allergy of the middle or internal ear is suspected when there are other allergic symptoms, when an aural discharge is very mucoid and resistant to treatment and when eosinophils are found in the secretion

The line of thinking and recent emphasis on stress autonomic influence and allergy has been applied by Phillips[13] even to multiple sclerosis He notes that many consider allergy as playing a major role in etiology and he regards the personal, emotional problem of the patient as perhaps the

most important factor He reasons that we are familiar with urticaria resulting from emotional and food allergy, having a common embryologic origin with the skin, it seems that tissue of the central nervous system may also respond with isolated areas of edema and pressure Degenerative changes may or may not result The cause of multiple sclerosis is unknown, but it does not occur in animals nor can it even be produced in animals The most common symptoms are double vision and paralysis of an extremity but not infrequently one notes vertigo, headache, tinnitus and hearing loss

Is there anything which favorably influences all types of allergic reaction? It seems to Rawlins[14] that from such a starting point it might be possible to develop a sound hypothesis of allergy Cortisone may be an answer His concept is that allergic edema occurs in the amorphous substance of subepithelial connective tissue This mesenchyme contains hyaluronic acid which in normal individuals is a firm gel The allergic reaction liberates many substances Histamine has been regarded as the most important but Rawlins considers that hyaluronidase is also of importance, liquefying the firm gel and making it edematous Cortisone affects this edema by neutralizing the hyaluronidase This hormone, then, is an antihyaluronidase factor, as are also the antihistaminic drugs In proposing this concept he does not overlook — in fact he emphasizes — the local autonomic dysfunction in allergy and the autonomic influence on the hormonal system

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ITEMS ON NUTRITION

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NUTRITION AND RELATED PROBLEMS

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Two decades ago came the great change in Otolaryngology Practice and interest and the literature had largely featured surgery Then came the sulfa drugs and then the antibiotics—and now our specialty is more in the medical than in the surgical field Hilger,[1] however, considers that our opportunity has been broadened and that the prophets of doom have not spelled the end of otolaryngology He feels that its scope is now enlarged by a closer integration of our field with general medicine — that the otolaryngologist has become more of a doctor and less a narrow and isolated specialist.

Interest in nutrition is a symbol of this trend. Likewise studies of the endocrines, autonomic influence stress and allergy

To some nutrition simply means food, if however, it is defined as the sum of all processes by which the body is nourished, or as the sum total of metabolic processes, both anabolic and catabolic, which result in the health or disease of tissues or simply as 'what accounts for the health of tissue, good or bad' — nutrition might actually be considered to include these other related subjects At any rate nutrition, endocrines, autonomic influence stress and allergy are all

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stressed that the creation of vitamins by bacteria in the intestine is obviously of great importance in nutrition — and that anyone who prescribes sulfa drugs or antibiotics is deeply concerned with their action on these bacteria We said that the time was not yet when it could be stated that the sulfa drugs or antibiotics (1) lessen the supply of vitamins and (2) also permit yeasts and molds to flourish — but that there was a trend of opinion in that direction The evidence indicated that (1) physicians, especially otolaryngologists, should be watchful and aware of these two new "Cautions", (2) we should be more hesitant in giving antibiotics so freely, especially for trivial ailments and (3) it would seem advisable to give B Complex with the antibiotic

Since that time, new evidence seems to confirm these suggestions which we made with some hesitation last year In a comprehensive survey Smith[16] calls attention to the complex balance which exists among microorganisms constituting the normal flora of the body This balance is disturbed by antibiotics, with resulting vitamin deficiencies or actual new infectious disease syndromes The importance of normal flora was not appreciated until it was disorganized by chemotherapy In the struggle among themselves bacteria and fungi were employing their own antibiotics as offensive weapons long before they were discovered by man. Most of the known antibiotics which kill bacteria are produced by fungi antibiotics derived from bacteria kill fungi but unfortunately they are toxic for man Following antibiotic therapy monilia are often found in serious infections of the mouth and pharynx, vagina and lungs and fatal infections have occurred following invasion of internal organs Although some intestinal bacteria may be destroying vitamins, most of them are engaged in synthesizing K" and members of the B Complex group The amount of absorption has been questioned but it seems probable that some vitamins are absorbed from the colon Even a small supplement from this source may be of great importance

Monilial infections of the mouth, intestinal tract, bronchi lungs skin and endocardium continue to be reported following penicillin, aureomycin, chloramphenicol and terramycin therapy The Lederle Laboratory suggested to McVay and Sprunt[17] that esters of paraben might prevent development of monilia which sometimes follows antibiotic therapy The monilia flourish most frequently in the large bowel without serious consequence, however, deaths have occurred from moniliasis in other organs These esters have been employed in foods and drugs as preservatives for many years The methyl ester of paraben is effective against molds and the propyl ester against yeasts The investigation used two preparations, one of aureomycin alone, the other of aureomycin with the paraben esters Oral, vaginal and rectal studies were made on 186 patients The results indicated that esters of paraben are of value in preventing overgrowth of monilia following aureomycin therapy

We are reminded by Patton[18] that the chief causes of death and disability have always been violence, infection and degenerative disease It is probable that infection dates from those forgotten years when man began to lead a communal existence Against bacteria man has had little or no defense until a very short time ago, only within the last few centuries has any effort been made against them — beginning with quinine and the heavy metals The deliberate creation of our modern drugs is a far cry from the development of quinine In the 17th century Peruvian natives relieved a patient, sick of "intermittent fever", by infusions of a bark, and in honor of her husband, Count Chinchon, Viceroy of Peru, this bark came to be called "Cinchona" So its alkaloid, quinine, became the first "wonder drug" Later came vaccines and anti-sera, and the past twenty years have finally seen the direct attack upon bacteria by the sulfonamides and antibiotics

It is not too much to say at the present time that, for acute conditions, perhaps half of all medical and surgical patients receive antibiotics as part of their treatment Pulaski[19] lists seven as now commercially available In surgery they are useful before and after operation They are most effective in acute conditions characterized by cellulitis Failure is not necessarily the fault of the antibiotic but may be explained by (1) the use of the wrong antibiotic for a susceptible or ganism, (2) drug resistance (in streptomycin therapy), (3 inadequate dosage or (4) blind reliance on antibiotics as substitute for surgery Fleming said "Antibiotics simpl attack the bacteria — the surgeon must treat the patient"

It seems to Scholtz and Williamson[20] that dermatologist are on the verge of a great simplification in their specialt in that many disorders due to lack of "A" can be brough together as variants of the same basic disease — abnorm keratinization They hail an advance in "A" therapy in th it can now be given in water instead of oil, results are mo complete and more rapid on much smaller doses Incidentall it is more palatable — having no fishy taste Signs of th lack of 'A" come slowly — and of reversal, equally slowl Exophthalmos may result from excess of the thyrotropic ho mone of the pituitary, thyroid extract helps in the rat b not in man. The authors think highly of Barber's[21] rece concept of acne. The essential lesion is the comedone, appears *pari passu* with pubic and axillary hair, these a known to depend upon stimulation of the pilo-sebaceous sy tem by androgens, acne is "cured' by adequate doses estrogen. The authors add what they regard as other facto in acne — hypothyroidism, disturbed "A" metabolism, an mia, physical fatigue and emotional stress They recomme a high protein diet. The endocrines concerned with ha growth are adrenal cortex, gonad, thyroid and anterior pit tary True sexual hair in males is dependent upon the gona coarse hair in the external ear is seen almost exclusively the male.

An extensive and helpful study of nutrition is given Rosenvold[22] Covering many contributions he applies them everyday practice From his own experience he confirms th the trouble is rarely due to lack of a single food factor although he refers for example to improvement by 'B$_2$" alc of seborrhea, fissures at the corners of the mouth and che sis. As to allergy, it is his belief that the nutritional appro will eventually overshadow the immunologic approach He impressed with the interrelationship between vitamins a hormones The use of endocrines must extend beyond the dispensing of thyroid extract, the utilization of proteins and minerals may require the prescribing of hormones appropriate to the individual patient

Pollack[23] notes that certain oral lesions often develop in patients who lack protein, they resemble those of “B_2” or niacin deficiency — but massive doses of these vitamins may prove ineffective Now, if enough protein is given, even with smaller doses of vitamins these lesions may rapidly disappear In brief, lack of a vitamin may produce a lesion although there is good caloric and protein intake, but these same lesions may occur on an adequate vitamin intake in the absence of adequate protein These interrelationships must be borne in mind It is wise not to rely on one single sign as an indication of the lack of a specific nutrient If the patient shows angular stomatitis and also cheilosis or facial seborrhoea or corneal vascularization or a magenta-colored tongue — a lack of “B_2” may be safely suspected To diagnose “A” deficiency one must find certain changes in the eye and in the skin “A” deficiency is noted chiefly in epithelial structures, ninety per cent of those showing this dermatosis also have eye manifestations Lack of “B_2” may exhibit oiliness, greasy, flaky yellow scales and an erythema There is some evidence of a relationship of acne to the B Complex Certainly, several factors may affect a sebaceous gland, particularly “A” and “B_2” Lack of “A” may cause xerophthalmia, keratomalacia and nyctalopia Giving large amounts of “A” may confirm these diagnoses Lack of “B_2” may show at the angles of the mouth linear cracks radiating laterally, these open sores — perleche — if infected, may leave permanent scars However, it is well known that often these lesions respond to “B_2” only if adequate protein is also given, the main lack may be in protein and the vitamin may serve only as a supplement In examining the tongue daylight is preferable The tip should project beyond the lip, a spatula is drawn over the dorsum from back to front This is against the grain of the filiform papillae Ruffling the papillae reveals the true status of their growth and the color of the underlying tissue

True atrophy of these papillae not infrequently gives the appearance of hypertrophy of the fungiform papillae, conversely, hypertrophic fungiform papillae may be masked by the filiform if they are not brushed aside A hand lens or binocular loupe may reveal changes not apparent to the naked eye. Normal gums are light pink, closely adherent to the teeth. The earliest signs of gingivitis are seen below the dental margins, a hyperaemic change and purple color, such inflammatory changes are easily differentiated from scurvy which, once seen, with its spongy, friable, bleeding appearance cannot be confused with anything else

C'

Even Hippocrates described scurvy and as Krolicki[24] notes, Kramer[25] gave citrus juices in 1720 and stated "you will, without other assistance, cure this dreadful evil" Many do not realize that ' C" is found in all living plant cells and is also present in all animal tissues Only guinea pigs, the primates and man are unable to meet body needs by synthesis of "C" and must get it from foods

So much we know isn't so What is a normal diet? As McLester[26] says, we must not be governed by too many rules Man can nourish himself on widely different diets, in this he is very versatile Robust health is found in the Himalayan mountaineers who live on fruits and vegetables, in Arab tribesmen who subsist largely on milk, and in Eskimos who eat only fish and meat They all do well on what they are used to The normal diet of a person of Italian extraction is entirely different from that of the Russian immigrant. It has been generally considered that one gets scurvy if he doesn't eat vegetables and fruit — "C" being the main requirement. Stefanson[27] spent ten years living as an Eskimo in the Arctic when meat was not available they ate only fish month after month He began to like it, even fish that was "high" At first he longed for salt which, prior to Columbus, had not been used in America, when he finally secured some he enjoyed it hugely for a time, but it soon palled on him and when camp was moved he left the salt behind Living on this salt-free meat and fish he, his crew and the Eskimos maintained perfect health, and there was no scurvy

IRON

The amazing response of pernicious anemia to liver therapy naturally led to its unbridled use in all types of anemia Such shotgun therapy, which has been and still is so prevalent, is decried by Heck[28] who emphasizes that the treatment of anemia should depend directly upon the blood picture He makes it clear when we should use iron and when liver, there should usually be no question as to which is needed Most anemias fall into the iron-deficiency group, generally attributable to loss of blood, as in a bleeding lesion or menorrhagia For such anemias liver extract, "B_{12}" and folic acid are definitely not indicated Iron is usually given by mouth, if poorly tolerated it can be given intravenously For pernicious anemia, in sharp contrast, the best treatment is liver extract or "B_{12}" parenterally Folic acid is not needed Iron is not indicated In other diseases with megaloblastic anemia some patients do not respond to "B_{12}" but do improve on folic acid None of these medicaments is helpful unless there is a deficiency of that particular substance To this day vast sums are spent on iron, on liver extracts or on both together, with no regard whatever to the indications All we need do is to determine the type of anemia, give only the indicated medicament, and not mix treatments

CHLOROPHYLL

This remarkable substance was a "pioneer" in all Nutrition It provided plant life to feed earth's primitive animals — and all those since It continues to be a *sine-qua-non* today no chlorophyll, no plant, no plant, no animal

In the atom bomb tests at Bikini and Eniwetok seeds of corn were exposed to radiation These seeds were then planted and results observed[29] There developed freaks of many types, including striking changes in the chlorophyll Many of these mutants showed, instead of the normal green, a mottling from pale or yellow to albino. Without normal chlorophyll the plant cannot utilize sunlight. Theoretically, 20 per cent of the light energy from the sun can be transformed into chemical energy by a plant and laid down as carbohydrate material. In reality, only 1 or 2 per cent of light energy falling on, say, a cornfield can be harvested as plant material.

Morgan[30] states that chlorophyll consists of two components of slightly different composition. It seems odd to Taber[31] that the first mention of its deodorizing effect was made only three years ago, by Wescott.[32] Chlorophyll was isolated in 1911, and introduced into medicine in the 1930s by Burgi,[33] who considered it helpful in various anemias. A product devised by him has been available in England for many years, yet its deodorant properties were not even mentioned. Wescott first noted relief from odors in the mouth — from food, beverages and tobacco, halitosis of unknown origin, odors from perspiration, foot, menses and urine. Serling[34] gave it to dogs and found that it eliminated objectionable odors within 24 hours. No one noted any toxicity or any effect on digestive activity. Consequently Taber studied the effect on menstrual odors, which are presumed to arise from decomposition of blood and cellular debris. It was doubted that chlorophyll could eliminate such odors as they would appear to be beyond any metabolic influence — but the odors disappeared. The only speculation concerns the *modus operandi*. It is remarkable, but as yet no one has offered any explanation whatever. The skeptic shrewdly asks, "Why reeks the goat upon the hill — when all he eats is chlorophyll?"

Many clinical studies and reports have been made. Straubinger[35] has found that chlorophyll keeps wounds clean and promotes healing. He mentions that the iron radical in hemoglobin corresponds to the magnesium radical in chlorophyll; hemoglobin delivers oxygen and chlorophyll delivers CO. Horwitz,[36] likewise, states that both are concerned with oxygen-carbon dioxide interchange. There is this similarity in the physiologic action, and he suggests that this may have some bearing on chlorophyll's good effect in tissue repair. He thinks it should occupy a prominent place in dealing with rectal infections and wound repair in general Its value in the healing of wounds and burns has been reported by many It has little effect on bacteria and its beneficial effect on healing may be exerted through stimulation of the cell Incidentally foul odors disappear Weingarten and Payson[37] gave chlorophyll by mouth and noted striking reduction of offensive odor in colostomy patients Carpenter[38] found the local use of chlorophyll of definite value in treating 127 cases of chronic osteomyelitis and chronic ulcers Moss, Morrow, Long and Ravdin[39] studied local effects on wound healing, odor and appearance They noted that chlorophyll tended to produce a clean, granulating wound Compared with cases not receiving chlorophyll this series showed a decrease in the odor of foul smelling wounds Tremble[40] finds it useful in atrophic rhinitis with ozena After removal of crusts a solution of chlorophyll is instilled three times daily A 100 mg tablet of chlorophyll by mouth after breakfast and dinner is usually sufficient to relieve odor Also in cases of chronic otitis externa and media with foul discharge it cuts down the disagreeable smell

There always have been areas of semi-starvation and others of actual starvation Those who ever stop to think of it realize that the world's food supply is becoming less and less for more and more people As Osborn[41] says, parts of the earth, once living and productive, are now dying at the hand of man The time may come when our "plundered planet" will cease to supply enough food by the chlorophyll-plant-animal sequence Man would then be compelled to resort to an ultimate though not impossible method of creating food directly from the air and sunlight, following the method of chlorophyll

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INFLUENCE OF FENESTRATION SURGERY ON BONE CONDUCTION MEASUREMENTS[*]

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Several investigators have noted improvement in hearing by bone conduction following fenestration surgery[3,9] These observations are provocative, since the fenestration operation does not aim toward restoration of sensory-neural functioning One possible explanation for the observations is that the structural changes produced in the middle ear by surgery had a mechanical effect which modified the patient's responsiveness to bone conduction stimuli According to this view, the changes in bone response cannot be considered evidence that surgery improved cochlear reserve Neither can preoperative bone thresholds be accepted as pure measures of "inner ear" sensitivity The alternative interpretation is that bone measurements are sufficiently inaccurate so that the observed improvement following surgery was the result of chance and did not represent actual change in responsiveness to bone conduction stimuli Such an explanation conforms to the opinion of many workers, who feel that bone conduction thresholds are direct, if somewhat inaccurate, measures of cochlear function

The foregoing alternatives emphasize the need for further study of the effect which fenestration surgery has upon hearing by bone conduction Such investigation can help clarify three matters of importance First, it can contribute to our

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This report is a summary and extension of a doctoral dissertation submitted to the Graduate School Northwestern University The study was conducted under the auspices of the School of Speech and the Department of Otolaryngology Northwestern University

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understanding of the interpretation to be applied to bone conduction audiometry by demonstrating whether or not mechanically induced changes in bone threshold do occur as a result of surgery Second, if such changes do occur and their approximate magnitudes can be described, the surgeon will have at his disposal information which will help him to estimate with greater surety the amounts of inner ear involvement possessed by his candidates for the operation Third, if a basis can be evolved for correlating surgical effects on bone response with postoperative improvement in air conduction acuity, the operating surgeon will have a further means of evaluating the adequacy of each operation through comparison of observed results with anticipated restoration

These prospects gave rise to the experiment here reported Its purpose was to establish more definitely whether or not changed bone conduction sensitivity results from fenestration surgery and, if it does, to determine the approximate amount and direction of change throughout the audiometric range

— II —

The basic procedures of the study were simple Detailed preoperative and postoperative audiometric tests were administered to 58 consecutive cases selected for fenestration surgery* All tests were administered by one of the authors in the offices of the cooperating physicians A clinical audiometer, the Maico E-2, was used to determine pure tone thresholds for both air and bone Speech audiometry was performed by air with an Otarion Auditory Analyzer Each patient was given two series of tests†

A preoperative series was administered approximately two weeks before surgery, while a postoperative series was given about three and one-half months after the operation The data thus gathered were later subjected to appropriate statistical analysis

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*These persons were patients of Dr George E Shambaugh Jr and his associates They are therefore judged to represent a reasonable sample of the distribution of otosclerotics which competent otologists select for surgery

†These tests were independent of those administered by surgeons for the purpose of determining the candidates suitability for the operation.

— III —

Before considering the results obtained, it is pertinent to discuss briefly the controls which were instituted to insure adequacy of the audiometry These controls were of two types *1* empirical confirmation that the test instruments were in satisfactory calibration, *2* physical measurement of the performance of the instruments throughout the time span of the investigation

Ten subjects with normal hearing were tested on the Maico E-2 Audiometer at the beginning and, again, at the end of the investigation The average thresholds thus obtained for the various test frequencies are shown in Figs 1 and 2 The solid line in each figure connects the averages obtained at the beginning of the investigation while the broken line connects averages obtained at the conclusion Fig 1 summarizes the data for air conduction, and Fig 2 shows the bone conduction results One notes two facts of importance first the audiometer yielded essentially equivalent results at the beginning and at the end of the study This finding may be accepted as evidence of the instrument's stability, second, the average thresholds yielded by normal ears were consistently close to the zero hearing loss value One could for many clinical uses accept the audiometer as being in adequate calibration, however, it was felt that for the purposes of the present study, a correction should be applied whenever the mean of the combined data for normals deviated more than 2 5 db from the zero loss value In consequence, all references to the audiometric results obtained in this study are hereafter reported in terms of these corrections, which involved subtracting 5 db from all bone conduction readings for 250 c p s and adding 5 db to all bone readings at 1,500, 2,000 3,000 and 4 000 c.p s Likewise 5 db was added to all air readings at 1,500, 2 000 4,000 and 8,000 c.p s.

Additional checks were made on the corrected calibration of the bone conduction system. For one thing both air and bone tests were administered to 12 ears having perceptive loss, following the theory that a well calibrated audiometer should yield identical air and bone thresholds when the subject has a pure "inner ear" impairment *Fig 3 shows that* the averages of the corrected air and corrected bone thresholds yielded by these 12 ears agreed closely with each other

Second, the same comparison was made with normal ears Fig 4 summarizes the agreement between the two sets of corrected thresholds which emerged when 10 normal hearers were each tested twice The equivalence was even better for the normals, but the tendency observed with perceptive cases for bone readings to be slightly better than air was reversed for the normals [*] It is noteworthy that, when the two groups of data were combined as shown in Fig 5, the average thresholds for air are in almost perfect agreement with those for bone It is apparent that the corrected calibrations of the two systems were highly equivalent This conclusion was confirmed by the further discovery that the Maico E-2 gave results which were in close agreement with those obtained from a second audiometer whose calibration had been demonstrated clinically to be particularly good Thus, the calibration of the pure tone audiometer used in the present study was judged to be highly adequate for the purposes at hand

In order to determine whether the performance of the audiometer remained constant throughout the experiment, an artificial ear was used daily to measure its acoustic output [†] Table 1 shows that over a period of seven months, the acoustic output of the pure tone audiometer remained highly stable [‡] At six of the nine test frequencies, the range from the highest to the lowest reading over the entire seven months' period was 2 db or less The greatest range was only 2 6 db

The stability of the speech audiometer was also determined with the artificial ear, the 1,000 c p s calibration tone on the

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[*] This trend may have been due in part to masking from residual room noise even though all tests on normals were made in the soundproof chamber in the Northwestern University Audiological Laboratories.

[†] The artificial ear and its amplifier were manufactured by the Audio Development Co It included a 9-A coupler a 640-AA Western Electric microphone and a cathode follower which fed into a vacuum tube voltmeter

[‡] Appropriate equipment for similar measurements of bone conduction output was not available but it is believed that the bone system was also satisfactorily stable The reason for this opinion is that normal ears as already reported yielded essentially the same average bone thresholds at the beginning and at the end of the experiment.

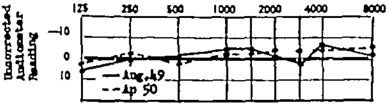

Fig 1. Averages of air conduction thresholds yielded by 10 subjects with normal hearing

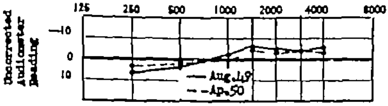

Fig 2. Averages of bone conduction thresholds yielded by 10 subjects with normal hearing

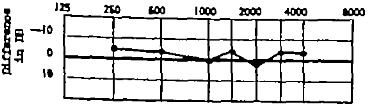

Fig 3 Agreement between averages of corrected air and bone thresholds yielded by 12 patients with pure nerve losses. Values below zero line indicate that bone was better than air

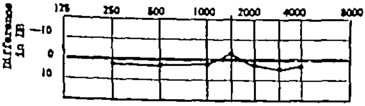

Fig. 4 Agreement between averages of corrected air and bone thresholds yielded by 10 subjects with normal hearing Values above zero line indicate that bone was better than air

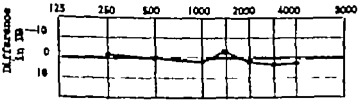

Fig. 5 Agreement between averages of corrected air and bone thresholds for combined group of 10 subjects with normal hearing and 12 patients with pure nerve losses Values above zero line indicate that bone was better than air

TABLE 1

Summary of Daily Measurements on Acoustic Output at Arbitrary Settings of the Maico E-2 Audiometer
Results Expressed in Decibels re 0002 Dynes/Cm^2

Frequency	Mean SPL	Lowest Reading	Highest Reading	Range from Lowest to Highest
125	104 0	102 6	105 2	2 6
250	104 9	103 9	105 5	1 6
500	104 4	103 5	105 1	1 6
1 000	102 7	101 8	103 4	1.6
1,500	101 3	100 3	102 3	2 0
2,000	101 2	99 8	101 8	2 0
3 000	99 9	98 6	100 4	1.8
4,000	103 6	102 0	104 6	2 6
8 000	101 0	99 7	101 9	2 2

test record being used as the acoustic signal during the daily measure on output The total range of all readings during the entire experiment was only 1 8 db The adequacy of calibration for this audiometer was checked empirically by obtaining the speech thresholds of normal ears at intervals throughout the study

The foregoing measurements gave the writers confidence that the test instruments were in satisfactory calibration and that they possessed high consistency in output throughout the time span of the study

—IV—

As would be expected in any consecutive series of patients selected for the fenestration operation, the 58 cases under investigation varied substantially in the preoperative levels of their hearing The average preoperative acuity for the entire group is reported in Fig 6

The mean impairment by air for pure tones in the ears selected for surgery varied from one frequency to another and ranged between 55 and 60 db The average losses in the opposite ear were slightly smaller, lying between 45 and 50 db The ears selected for surgery showed an average loss for speech of 57 db, while the contralateral ears averaged 43 db of loss for speech. These discrepancies between ears reflect the surgeons' practice of choosing the poorer ear for operation.

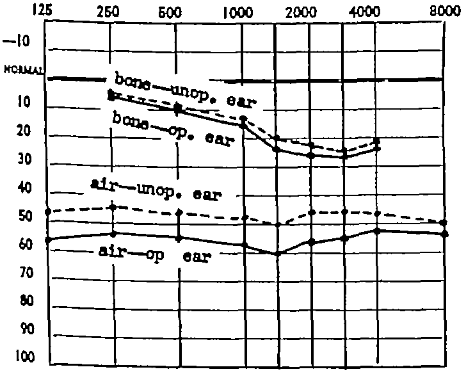

Fig. 6 Average preoperative hearing of 58 patients selected for fenestration surgery

By contrast, as is also evident in Fig 6, the bone conduction acuity of the ears scheduled for surgery was only slightly inferior to the acuity for the opposite ears. The separation between the mean values for the two ears was not more than 3.3 db for any test frequency The two curves slope off relatively uniformly, with the least loss being approximately 5 db for 250 c.p.s. A slight depression may be noted in the region from 1 500 through 3,000 c.p.s., so that the total configuration resembles the profile of a skillet. Considering the overall picture, the average levels were near normal — as would be expected in a population selected for fenestration surgery

The mean age for the group was 39 years Two-thirds were between 29 5 and 18 5, while the youngest was 19 and the oldest was 60 Half of the subjects were under 38 years old

Viewed in terms of Shambaugh's categories of suitability for surgery,• the group consisted of 31 class 'A," 25 "B" and two "C" cases In the age group under 38 there were 19 "A" and 10 "B" cases, while those over 38 included 12 "A," 15 "B," and two "C" cases Considering only the ears selected for surgery, the average bone loss in the speech frequencies (500 to 2,000 c p s) for all "A" cases was 12 8 db, as compared to 23 0 db for the "B" cases, and 34 4 db for the two "C" cases The average losses by air over the 500 to 2,000 c p s range were, respectively, 52 0 db, 59 2 db, and 62 5 db for the three groups

— V —

In the group under consideration the fenestration operation produced marked improvement in the air conduction thresholds for the operated ears By contrast, the thresholds for the unoperated ears remained essentially unchanged Table 2 demonstrates this fact in terms of spondee thresholds and average pure tone hearing in the speech range Figs 7 and 8 supply the analogous information for the various test tones in the audiometric range

TABLE 2

Comparison of Mean Preoperative and Postoperative Levels of Losses for Air Conduction Stimuli

	Operated Ears			Unoperated Ears		
	Preop Level	Postop Level	Gain in Db	Preop Level	Postop Level	Gain in Db
a. — Average of 500, 1,000, 1,500 and 2,000 c p s						
Under 38	53 7	28 5	25 2	44 1	42 4	1 7
Over 38	60 2	33 9	26 3	51 4	50 8	0 6
Total Group	57 0	31 1	25 9	47 8	46 6	1.2
b — Spondee Threshold						
Under 38	53 4	28 2	25 2	44 1	41 6	2 5
Over 38	60 5	33 3	27.2	52 2	50 2	2 0
Total Group	57 0	30 8	26 2	48 1	45 9	2 2

Since the mean change in the unoperated ears was very small, almost the total gain in the operated ears may be accepted as surgical improvement The stability of unoperated ears allows a high degree of confidence in the audiometric results for the operated ears The average improvement which the latter achieved at each test frequency is, therefore, worthy of review Table 3 reports the pertinent statistics, which may be summarized as follows

TABLE 3

Summary by Frequencies of Average Gain in Air Conduction Acuity Produced by Fenestration Surgery

Test Frequency	Mean Improvement in Decibels	Standard Deviation of Improvement	Standard Error of Mean
125	23.5	11.5	1.5
250	24.4	10.7	1.4
500	25.1	8.9	1.2
1,000	25.9	9.8	1.3
1,500	26.7	10.4	1.4
2,000	25.4	9.2	1.2
3,000	16.9	10.7	1.4
4,000	12.5	11.3	1.6
8,000	8.8	13.4	1.9

1. The average air conduction gain for frequencies from 125 c.p.s through 2,000 c.p.s was approximately 25 db
2. The average air conduction gain became progressively less above 2,000 c.p.s., being approximately 17 db at 3,000 c.p.s., 13 db at 4,000 c.p.s., and 9 db at 8,000 c.p.s. This tendency is in general agreement with the findings of Thurlow, Davis and their associates

Furthermore, on the basis of *T* tests, comparing the gains at different frequencies, the configuration as described may be accepted as a valid representation of the group's average improvement by air when measured three months postoperatively

When coefficients of correlation were computed, a fairly high interdependence was found to exist between the air conduction gains for adjacent frequencies The values of *r* ranged from 0.54 to 0.73 The parallelism was slightly more pronounced for tones in the low frequency range. Individual variations existed, but the improvement which a patient received tended to be generalized and to reveal itself proportionately over a wide frequency range.

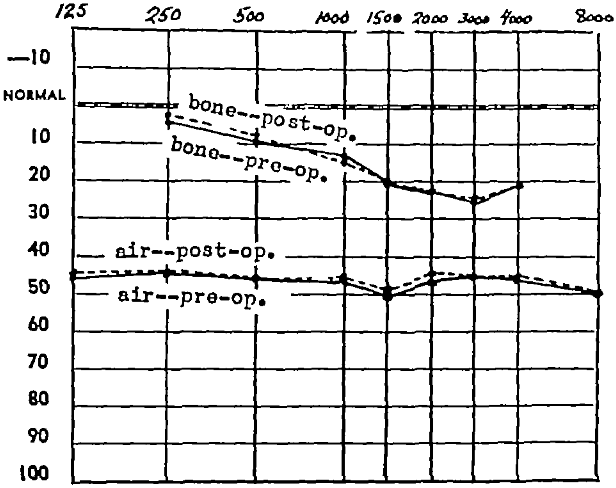

Fig 7 Comparison between average preoperative and average postoperative thresholds for air and for bone obtained from the unoperated ears of 58 patients who underwent fenestration surgery

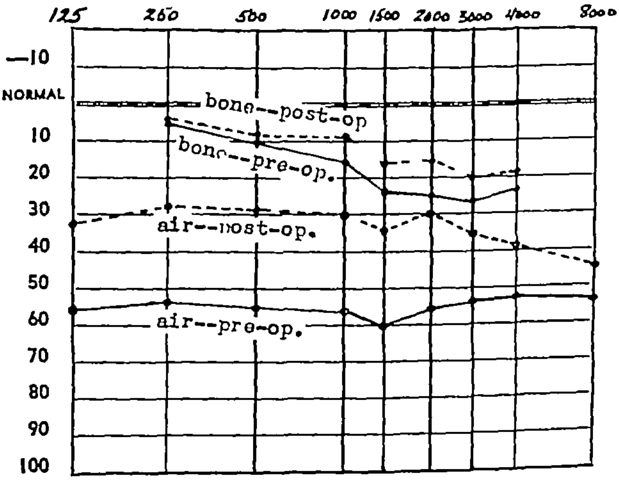

Fig 8 Comparison between the average preoperative and average postoperative thresholds for air and for bone obtained from 58 ears subjected to fenestration surgery

There was a substantial tendency for the patients with greatest losses to achieve greatest postoperative gains, however, statistical analysis showed that the total loss *per se* was not the factor related to gain Instead, as would be expected, the average gain bore good interdependence with the preoperative conductive component as gauged by the air-bone gap (R — 0 48), however, it was apparent that the relationships were complex and that other variables were active to produce individual differences

Age was not a critical factor in the amount of improvement in air conduction hearing, as can be seen from Table 2 The average gains for the two age groups were essentially equivalent. Older subjects showed an average postoperative loss greater than the younger subjects because their preoperative hearing was also poorer, therefore to the extent that older patients tended to show greater initial impairments because of greater secondary nerve involvements, age was an indirect determinant of postoperative levels, but not a determinant of amount of improvement

When subjects were subdivided according to suitability for surgery, the same relationship was observed The 80 class "A" cases gained 26 7 db in the speech range which was only slightly greater than the 24 3 db gain of 25 class "B" cases

The 'A' cases achieved a mean postoperative level of 26 1 db while all 45 cases whose initial losses in the speech range were 60 db or less averaged 28 6 db of loss postoperatively The acuity of the majority of the subjects was restored to a "practical level" of 30 db or better

As shown in Table 2, improvement in spondee thresholds paralleled closely pure tone results for the 500 to 2,000 c.p.s range A coefficient of correlation of r — 0 84 was found between the gain as expressed by the 500 to 2,000 c.p s average and the gain as measured with spondees The conclusion which emerges from these findings is that, insofar as the present subjects are typical, otosclerosis produces a relatively uncomplicated impairment in the sense that acuity for pure tones and acuity for speech are not reduced disproportionately to one another The two modalities show a similar parallelism when postsurgical results are considered Both offer good estimates either of preoperative hearing loss or of surgical benefit This conclusion is somewhat different from the interpretation made by Davis and his associates,[8] but the disagreement is amply explained by the fact that these investigators included data for 2,896 c.p s in their computations

— VI —

In the group under consideration, the fenestration operation produced a definite shift in the bone conduction thresholds for the operated ear, while thresholds in the unoperated ears remained essentially unchanged Table 4 demonstrates this fact for the 500 to 2,000 c p s averages Figs 7 and 8 summarize the results by individual frequencies when average thresholds are plotted on the audiogram Fig 9 gives a more precise picture of the average shifts observed

TABLE 4

Comparison of Mean Preoperative and Postoperative Bone Conduction Levels Averaged Across the 500 to 2,000 C P S Range

	Operated Ear			Unoperated Ear		
	Preop Level	Postop Level	Gain in Db	Preop Level	Postop Level	Gain in Db
Under 38	14 9	9 5	5 4	13 8	13 2	0 6
Over 38	21 7	15 3	6 4	19 0	19 6	0 6
Combined	18 3	12 4	5 9	16 4	16 4	0 0

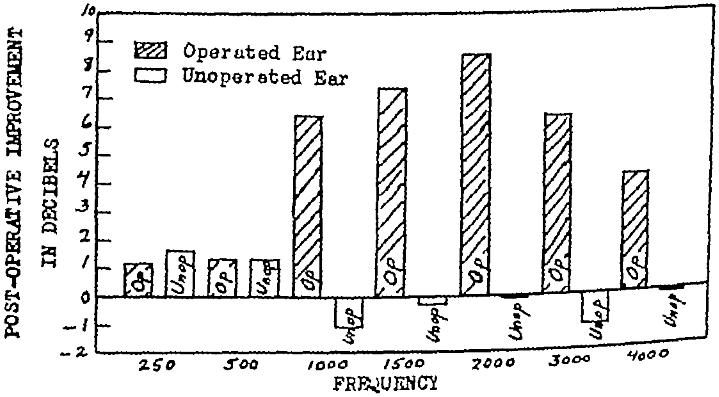

Fig 9 Comparison between mean improvements in bone conduction sensitivity for operated and for unoperated ears of 58 patients

Nonfenestrated ears revealed virtually no shift, inasmuch as the variation between pre- and postoperative bone thresholds was at no frequency greater than 1 6 db By contrast, postoperative averages for fenestrated ears revealed gains over preoperative levels of 1.2 db at 250 c.p s., 1 4 db at 500 c.p.s., 6.5 db at 1,000 c.p.s., 7 4 db at 1,500 c.p s , 8 5 db at 2,000 c.p.s., 6 4 db at 3,000 c.p s , and 4 2 db at 4,000 c.p s Thus, the operated ears revealed a group pattern in which almost no shift occurred for test tones below 1,000 c.p s , but a fairly uniform shift averaging 6 6 db occurred throughout the range from 1,000 c.p s. through 4,000 c.p s., furthermore, when the data were subjected to statistical tests of significance, it became clear that the small shifts evidenced by unoperated ears could be attributed to chance, while the larger changes in bone sensitivity found from 1,000 c.p.s through 4,000 c.p.s. in the operated ears were attributable to surgery The foregoing results are important in demonstrating two things First, since fenestration surgery ordinarily modifies only the conductive component of the hearing loss mechanical factors may modify bone conduction thresholds to a measurable degree. Second, fenestration surgery produces a mechanical shift in response to bone stimuli which is a partial reverse of the preoperative otosclerotic notch in the bone curve described by Carhart.[1]

Individual patients deviated from the foregoing pattern to a substantial degree so that this pattern must be viewed as only a group trend For example, the average bone gain (over the 500 to 2,000 c.p.s band) for class 'A' cases was 5 5 db while it was 6 4 db for class "B" cases and 7 5 db for the two class 'C" cases however, although the correlation was low (R = 0 35 ± 0 11) a slight tendency was noted for greater gains to be associated with greatest initial losses for bone In contrast, within the limits represented by the patients subjected to study, the amount of bone gain was not found to be a function of the preoperative magnitude of the conductive component of loss as gauged by the preoperative air-bone gap (r = -0.26 ± 0 12), nor was it a function of the age of the patient. Finally, postoperative thresholds for bone at adjacent test frequencies showed a moderate tendency toward parallel shifts at the extremes of the audiometric range, but the parallelism was substantially reduced for central frequencies Marked individual differences existed in the pattern of postoperative gain for bone

The only conclusion which appears possible from the configuration of results just outlined is that factors as yet unknown were at work in individual cases When these factors are discovered through future research they may help us to understand and to evaluate individual cases In the meantime, we may accept the fact that a clear pattern of bone conduction gain is evident as a group trend

— VII —

Even though the mechanical factors that influence bone conduction thresholds of otosclerotics are such that the bone audiogram gives only an approximate picture of cochlear reserve, it is, nonetheless, interesting to review the effect of fenestration surgery upon the gap between the air and bone curves

Air-bone gaps, for the ears which underwent surgery, were computed for the 500 to 2,000 c p s range The average initial air-bone gap for all 58 subjects was 38 7 db and the mean postoperative gap was 18 8 db Preoperative gaps averaged 40 0 db for the 30 class "A" cases Their residual gaps averaged 18 8 db after surgery, so that the mean reduction in the size of the gaps was 21 2 db The initial gaps for 25 class "B" cases averaged 36 2 db, while their average reduction was 17 9 db and their residual level was 18 3 db Thus, class "B" was left with a postoperative mean which agreed almost identically with that of the class "A" cases

The implication from the foregoing figures is obvious namely, the residue of conductive component following surgery was, on the average, independent of the magnitude of original impairment Individuals deviated from the group average, yet the operation, when viewed in terms of only the conductive component, tended to bring all patients to the same terminal point, regardless of preoperative differentials This finding confirms the Davis and Walsh concept of a postoperative conductive impairment which is unavoidable because the ossicular mechanism is disrupted surgically*

The size of the gap differed from one frequency to another Table 5 summarizes results for the group as a whole The following trends are apparent from the table First, the initial air bone gap showed a progressive decrease with rise in the test frequency, being 17 6 db at 250 c p s , but only 26 5 db and 29 1 db for 8,000 and 4,000 c p s , respectively Second, the mean reduction in gap resulting from surgery was progressively less with increased frequency Last, the residual air-bone gap was smallest for the middle frequencies, being 14 3 db at 2,000 c.p s In contrast, the residual gaps for 250 500, 1,000 and 4,000 c.p s were all greater than 20 db The possible significance of those variations is discussed below For the moment, the point to emphasize is that the conductive component of the loss due to clinical otosclerosis is not equally modified at different frequencies by surgery

TABLE 5

Comparison of Initial and Residual Air bone Gaps at Individual Frequencies.

Test Frequency	Mean Initial Gap in Db	Mean Residual Gap in Db	Mean Reduction
250	47 6	24.1	23 2
500	44 7	20 8	23 9
1 000	40 7	21.2	19.5
1,500	37 6	18 3	19 3
2 000	31 2	14 3	16 9
3 000	26.5	15.9	10 6
4 000	29.5	20 8	8.3

— VIII —

The findings reviewed above demonstrate clearly that surgical reorganizaton of the middle ear structures does change bone conduction thresholds One immediately wonders whether the postoperative bone thresholds are true indications of cochlear sensitivity or whether they, too, are displaced by residual mechanical influences In other words, one wonders whether the postoperative bone audiogram gives an undistorted picture of cochlear function or whether the picture is obscured by variations in response due to the physical state of the surgically modified ear

The data of the present study were analyzed from the standpoint of the foregoing question Basically, the question may be phrased as follows "Is the postoperative separation between a patient's air and bone conduction thresholds equal to the residual conductive impairment he possesses?" If so, his bone audiogram is determined fully by his cochlear reserve, and, if not, his bone audiogram must still incorporate an additional mechanical effect Analysis of this question consisted of determining in the manner described below how well the air-bone gaps observed after surgery agreed with the patient's residual conductive impairment as computed by an alternative method

The first step was to estimate residual conductive impairment without relying upon bone thresholds in doing so Davis and Walsh have demonstrated that such an estimate may be derived entirely from the air conduction thresholds yielded by groups of patients subjected to fenestration surgery[2] Their procedure, which they employ with speech thresholds, is simple It is illustrated in Fig 10 with the speech thresholds obtained in our own study The preoperative and postoperative results for fenestrated ears are plotted against one another It will be observed that the results are not randomly distributed Instead, they form a scattergram with a definite pattern which allows one to specify the limit of surgical restoration of hearing

It can be seen in Fig 10 that a number of patients with preoperative losses of 60 db or less had their hearing restored sufficiently so that their residual losses were about 20 db, but only a few achieved results which were even slightly better than this Thus the group evidenced a limit in surgical benefit Davis and Walsh assume that this limit, which their data also show to be 20 db, is the inevitable price of disrupting the ossicular mechanism through the fenestration operation In other words, the operation leaves a residual conductive impairment whose magnitude may be estimated as equalling the deficit in acuity which the superior surgical result retains This residual conductive impairment is represented in Fig 10 by the vertical portion of the boundary designated as the Limit of Anticipated Restoration.

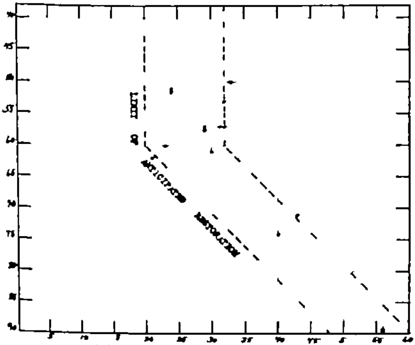

Fig. 10 Distribution of speech thresholds showing surgical results in relation to preoperative hearing level

Obviously, a patient with a nerve loss will fall short of restoration to normal hearing by an amount at least equal to the aforementioned conductive residue plus his degree of nerve loss. The sloping section of the Limit of Anticipated Restoration shown in Fig 10 represents this fact. It indicates that the cases with *more severe* preoperative losses failed to reach the 20 db residue. Those in this latter category who obtained the best surgical results had postoperative losses which exceeded 20 db by an amount equalling the difference between their preoperative losses and 60 db

Stated in another way when results are plotted as shown in Fig 10 and a boundary is arbitrarily drawn so that it encompasses the best results for the group, one may estimate the maximum preoperative conductive loss produced by stapes fixation This maximum is indicated by the point at which the boundary breaks from its vertical course and begins to diagonal to the right In the present instance, as in Davis' and Walsh's study, this break is associated with a preoperative loss of 60 db One concludes that the maximum loss for speech due to the conductive lesion of stapes fixation did not exceed 60 db Patients with greater impairment than this possessed nerve involvement in addition to a conductive involvement, as, of course, did some patients with lesser total impairment

The fundamental point in the above discussion is that two important values may be derived by employing the foregoing procedure and by disregarding for the moment the bone conduction results One value is the maximum amount of conductive loss to be expected from stapes fixation, while the other value is the postoperative conductive deficit produced by surgical interference with the ossicular system The latter is our primary concern, but the former is of sufficient interest so that it will also be given brief attention in the discussion which follows

An analysis similar to that described above was made of the air conduction thresholds yielded by our subjects at each of the audiometric frequencies we employed Fig 11, which summarizes the data for 2,000 c p s , is typical of the results that emerged Here, an Estimated Limit of Operative Restoration was arbitrarily drawn so that few scores lay to the left of it, but so that the majority lay along the boundary or bunched close to it on the right Assuming the principles postulated by Davis and Walsh, the vertical portion of the boundary indicates the approximate size of the conductive deficit due to ossicular disruption This vertical portion is, in the present instance, 20 db to the right of zero on the postoperative scale One, therefore, estimates that the minimal conductive deficit to be expected postoperatively at 2,000 c p s is 20 db Moreover, the point on the preoperative scale at which the boundary breaks to take a diagonal course is an indication of the maximal conductive impairment which stapes fixation produces preoperatively at the frequency under study The present data led to the belief that this maximum is 55 db for 2,000 c.p.s.

Similar analysis was made of the scores for each frequency from 125 through 8,000 c.p s The findings are summarized in Fig 12, which is in the form of an audiogram

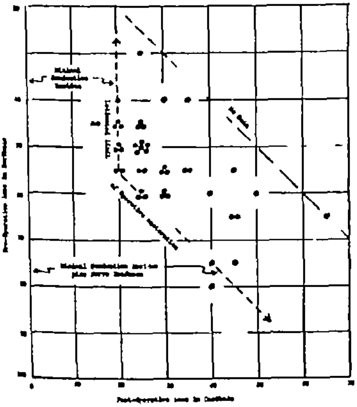

Fig 11. Distribution of air conduction thresholds for 2 000 c.p s showing surgical results in relation to preoperative hearing level.

The lower curve of Fig 12 plots the maximal conductive impairment to be expected preoperatively at each frequency It is interesting to note that the average of the maxima across the 250 to 2,000 c.p.s range is about 60 db* and that the maxima are somewhat smaller than this for still higher frequencies

Our main interest at the moment is the size of the postoperative conductive deficits associated with different test frequencies The latter are shown by the upper curve in Fig 12 The reader will observe that these deficits appear to be constant from one pure tone to another The findings are interpreted to mean that, as judged from the results of the 58 fenestration cases under consideration, the minimal conductive deficit following ossicular disruption was approximately 20 db across the frequency range from 125 through 4,000 c p s and 15 db at 8,000 c p s

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* Occasional clinical cases are encountered wherein the maximal conductive involvement at low frequencies appears to exceed 60 db appreciably but these cases are sufficiently rare so that they do not exert an important influence on the results obtained in analyzing group trends.

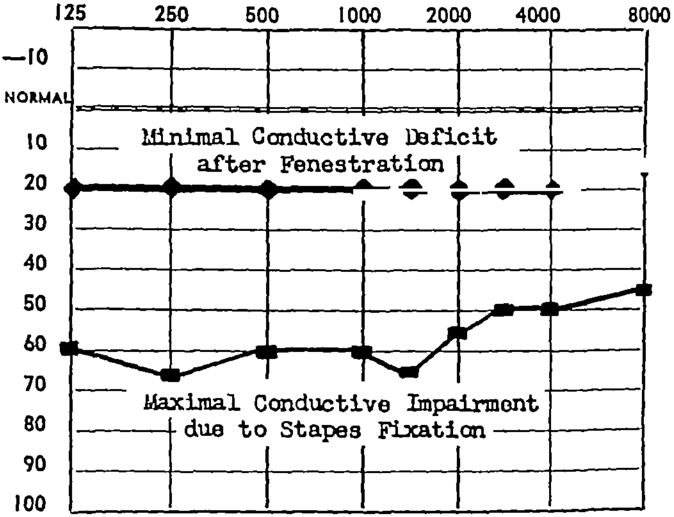


Fig 12 Estimated limiting values of conductive impairment found in otosclerosis.

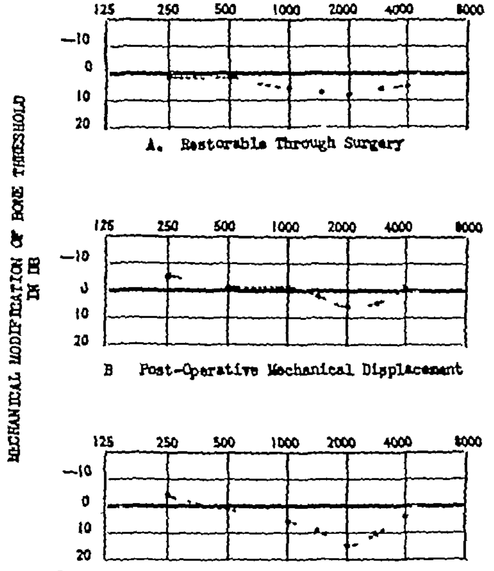
— IX —

It is the foregoing estimate, derived entirely from air conduction measurements, which may be compared with the average air-bone gaps for the same group of subjects in order to judge whether or not their postoperative bone thresholds were undistorted indications of cochlear function As will be recalled, the size of the postoperative air-bone gaps varied from one frequency to another across the band from 250 through 4,000 c p s, which was the range employed for bone measurements in the present study Now, remembering that the actual conductive deficit was estimated to be about 20 db for these frequencies, the amount by which the air-bone gap at any frequency deviated from 20 db may be interpreted as indicating the mechanical displacement in bone response which persisted at that frequency after surgery Pursuing the foregoing assumption, one needs merely to compute the differences involved in order to estimate the effect of mechanical influences on the postsurgical audiogram. These differences, as derived from the present study, were –4 4 db at 250 c.p.s , –0 8 at 500, –1 2 at 1,000, 1 7 at 1,500, 5 6 at 2,000, 4 1 at 3,000, and –0 8 at 4,000 c.p s These values appear to be a reasonable indication, from the data at hand, of the amount by which the bone response remained mechanically modified after surgery One may hypothecate that, on the average, bone thresholds obtained after surgery failed by the amounts listed above to give a true picture of cochlear function

— X —

Mention has been made of Carhart's observation that a typical distortion of the bone conduction audiogram appears preoperatively as a result of the mechanical influences exerted by stapes fixation The fact that the fenestration operation changes response to bone conduction stimuli may be viewed as indirect evidence that such distortion of the audiogram existed prior to surgery, however, there remains the problem of specifying the pattern and magnitude of the preoperative distortion in the bone curve. Without such information, estimates of cochlear function derived from preoperative bone audiograms must lack the precision one would like

It is a simple matter to compute, for the group under study and from the information at hand, the approximate size of the average preoperative displacement of the bone curve due to the mechanical influences of stapes fixation The procedure is shown graphically in Fig 13 One first draws Curve A, which summarizes the gains in bone sensitivity actually produced by surgery These gains have already been reported in Fig 9 however, in the present instance the curve is drawn below the zero reference line because we are at the moment imagining a preoperative condition that is, the fraction of the mechanical depression which subsequent surgery was observed to reverse One next draws Curve B, which is the mechanical distortion that we have just estimated to have remained after surgery This curve represents the fraction of the original distortion which, according to our estimate, surgery did not eliminate Finally, Curves A and B are combined to yield Curve C, which is our computation of the size of the preoperative distortion in bone sensitivity due to stapes fixation, *i e*, the size of the "otosclerotic notch." In other words, since Curve C is the sum of the observed restoration plus the postoperative residue which was not restored, it is an estimate of the average amount by which the bone measurements on the 58 subjects under consideration gave a false picture of cochlear function prior to surgery



A. Restorable Through Surgery

B Post-Operative Mechanical Displacement

C Total Pre-Operative Otosclerotic Notch (A plus B)

Fig 13 Calculation of the magnitude of the otosclerotic notch (Curve C) Derived by combining the bone sensitivity restorable through surgery (Curve A) with the postoperative residue of mechanical displacement (Curve B) which was estimated from the auditory responses of 58 patients

Expressed numerically, such a procedure gives the following values for the preoperative "otosclerotic notch," when these values are computed from the data of the present study

Stapes fixation appears to have improved bone sensitivity 3.2 db at 250 c.p.s., while mechanically depressing bone sensitivity, 0.6 db at 500, 5.3 at 1,000, 14.1 at 2,000, and 3.4 db at 4,000 c.p.s. It is interesting that Carhart,[1] in his original rough description of notch size, postulated no shift at 250 c.p.s., 5 db depression at 500, 10 at 1,000, 15 at 2,000, and 5 db at 4,000 c.p.s. The discrepancies between the present estimate and Carhart's original figures are not large. The data at hand leads to the belief that the original postulation was not seriously in error and that, on the average, the "otosclerotic notch" may be assumed to have approximately the shape heretofore described. There will, of course, be individual variations in clinical records and the significance of these variations needs further study, however, when one remembers that the audiometer measures hearing loss in 5 db steps and that a patient will respond to the first signal stronger than his threshold, a person having an "otosclerotic notch" which corresponds to our new estimate will yield a bone audiogram which is identical with Carhart's original postulation.[*] It may be concluded that we have at our disposal an average set of values which apply reasonably well for most cases of clinical otosclerosis. For the moment, the values suggested by Carhart may continue to be accepted as practical ones when correcting the bone curves of individual clinical patients.

The fundamental point underlying this whole discussion is that *allowance must be made for the fact that the bone conduction audiogram gives a distorted measure of the cochlear function possessed by a patient with stapes fixation.* Thresholds obtained before operation incorporate the "otosclerotic notch." The present study demonstrates that fenestration produces a partial reversal of the notch. The study also leads to the belief that thresholds obtained after operation incorporate a lesser mechanical displacement, so that even here the bone measurements are not fully accurate indications of neurosensory function, however appropriate allowances can be made when interpreting either the preoperative or the postoperative bone audiograms * Improved estimates of cochlear reserve should usually thus be obtained Among other things, such estimates based on postoperative tests administered at appropriate intervals may be compared with the estimate derived from the preoperative records The stability of a patient's cochlear function may thus be judged with greater accuracy and long term changes in hearing may be followed with greater confidence

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[*] For example if a patient's bone sensitivity at 250 c.p.s. is —3.2 db re normal threshold he will respond when the signal strength is zero rather than —5. Thus his audiogram will not reveal the mechanical shift in bone sensitivity which he actually possesses. Similarly the 3.4 db depression in sensitivity at 4,000 c.p.s. will be measured audiometrically as a threshold of +5 db. Analogous relationships exist at the other test frequencies.

— XI —

Since mechanical shifts in bone sensitivity are an integral part of the otosclerotic's auditory configuration, we are in a position to apply a new level of interpretation to the audiometric records of such cases Enough has been learned to help the otologist in making fuller use of bone conduction measurements in selecting candidates for fenestration and in evaluating the results of surgery Naturally, much more research is needed to reveal both the full nature of the phenomena involved and the variations for which allowance must be made For example, the present study gives a description of surgical results based on tests made three months after surgery This time lapse was probably sufficient so that hearing levels had achieved postoperative stability, but the matter needs further exploration Nelsson[5] has demonstrated, with measurements obtained during surgery, that fenestration produces responsiveness to bone stimuli, however, the values he obtained for this improvement differ substantially from those reported in the present study Additional research is obviously needed to plot the progression of change in bone conduction sensitivity associated with the postoperative recovery period Recognizing our need for additional knowledge, there are, nonetheless, several conclusions which may be drawn from the present study These conclusions are

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*For example Shambaugh[7] has suggested using corrected bone values as the basis for predicting the anticipated air conduction audiogram following surgery He merely adds 25 db of impairment to the corrected configuration of the preoperative bone curve He has demonstrated that, on the whole, his predictions are usefully close to the actual surgical results which he achieves

1 Fenestration surgery produces real improvement in responsiveness to bone stimuli throughout the range from 1,000 through 4,000 c.p s This fact is evidence that mechanical changes in the middle ear system modify bone conduction thresholds

2 The postoperative residue of conductive impairment appears to have a limiting minimal value of 20 db across most of the audiometric range Since the average air bone gap after surgery varies from one frequency to another and fails to conform to this value, a mechanical distortion of the bone audiogram remains after surgery

3 The magnitude of the average influence which stapes fixation has upon bone conduction thresholds may be estimated by adding the observed shift in bone sensitivity which surgery produces to the estimate of the unrestored residue of mechanical distortion This procedure yields values which agree reasonably well with those postulated by Carhart's earlier description of the otosclerotic notch. The results thus increase the confidence with which one may state that stapes fixation tends to produce a mechanically induced distortion of the bone conduction audiogram which tends to have a typical configuration

4 The foregoing conclusions refer to group trends Individual patients often show substantial deviations from these trends It is apparent that factors as yet unknown are operative and that further research directed at isolating these factors is needed

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FUNCTIONAL STUDIES ON LABYRINTHINE FENESTRATION IN ANIMALS — II [*]

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I—INTRODUCTION

Since 1942 a series of experiments designed to determine the effects of the fenestration operation upon the hearing function of animals has been performed at the University of Rochester A first report of this research[12] described experiments in which the animals' hearing was tested by means of cochlear potentials The present report is concerned with experiments in which the hearing of monkeys was measured by a conditioned-response technique (a method of behavioral observation) similar to that described by Culler *et al.*, both before and after the fenestration operation In addition the middle and inner ears were examined microscopically after the postoperative hearing measurements had been completed The results of the present series of experiments are not nearly so definitive as those of the earlier-reported experiments.[12] It is considered advisable, however, to publish them at this time because they do not agree with the conclusions which have been drawn from most of the published clinical data concerning fenestration

Case histories of fenestrated humans have emphasized a positive relationship between patency of the fistula and hear-

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[*] Communication from the former Institute of Audition at the University of Rochester Elmer A. Culler and Edward H Kemp Directors.

Submitted by the author in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Rochester

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The author makes grateful acknowledgment to Karl Lowy M.D who supervised the entire experiment, performed the surgery and examined the ear sections. The author is further indebted to Prof Alice Van Krevelen for the histological processing and to Prof G R. Wendt for editorial assistance.

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ing improvement It is claimed that, when an initial postoperative hearing improvement is subsequently lost, there is concomitant absence of a positive fistula symptom and (in cases where a revision was carried out) observable closure of the fistula with newly-formed bone[3] For this reason, most previous animal research dealing with the fenestration operation has been directed toward improving surgical techniques for creating a fistula which would not close with regenerating bone[10 11] The present research, however, was directed ultimately toward finding a correlation between anatomical structure and hearing function, and it has indicated that the postoperative hearing improvement was relatively independent of the open or closed condition of the fistula, furthermore, the results did not show any other single anatomical difference between the ears of those monkeys whose hearing was greatly improved and those whose hearing was improved little or not at all

These rather inconclusive results would appear to be applicable primarily to the study of the mechanics of the auditory transmission system and the changes induced in this system by the fenestration operation Although a hearing loss comparable to that found in cases of clinical otosclerosis was produced in the monkeys, the oval window was not occluded, and the fenestration operation consequently added a third functional window to the inner ear The fact that the making of this third fenestra by surgical means appeared to produce improved hearing in some monkeys we consider an important outcome of the present study, and this report of results is made with the aim of raising interest in the problems presented

With the purpose of obtaining the monkeys' audiograms and comparing histologic condition of the ear with them, the present experiment was divided into four fairly distinct parts

The first part was designed to meet the problem of deafening the monkey's experimental ear in a manner as similar as possible to that of clinical otosclerosis This was done surgically by removing the incus to interrupt the chain of ossicles, however, since we could devise no sure method of immobilizing the oval window, it was necessary to determine the actual amount of deafness due to exclusion of the ossicular function alone To this end, the monkeys' hearing losses following removal of the incus were determined and compared in both range and amount to the hearing loss measured in cases of clinical otosclerosis

The second part of our experiment consisted of the fenestration operation, followed by determination of the animals immediate postoperative changes in hearing threshold Because the largest number of animals was used in this phase of the study, some statistics were utilized in an attempt to make some generalizations concerning the results of the operation.

The third phase was a study of the duration of the post-fenestration hearing changes The monkeys hearing was tested at various intervals as long as their general health remained good or until some characteristic of their audiograms made histological examination of the ears desirable

The fourth phase consisted of examining microscopically sections of the middle and inner ears and relating these observations to each animal's most recent audiogram

II — EXPERIMENTAL PROCEDURES

A Animals Because of the similarity of their ears to those of humans and because their relatively high intelligence made training them and testing their hearing fairly simple, rhesus monkeys were chosen as the experimental animals Twenty-one monkeys, approximately equally divided as to sex and of about the same age (preadolescent) are included in the results

B Apparatus The audiometric tests of the monkeys were made in a sound insulated room similar to that described by Harris,[5] which contained a loudspeaker and the restraining cage for the animal This room had a one-way vision window directly opposite the cage through which the experimenter could observe the animal

The tones presented as stimuli were generated by a General Radio Type 608-A Oscillator, amplified, attenuated in fixed steps and delivered in the test room by a dynamic loudspeaker A brief shock stimulus of variable intensity was applied to the animal through leads to a chain harness around his chest and to the metal floor of the cage The onset and duration of the tone and shock were controlled by means of a relay system operated by a constant-speed rotating disc.* The experimenter was able to attenuate the tone in steps of 4 db These decibels of attenuation from a fixed sound level were recorded as the monkey's audiogram Since all data in this study are comparisons between these audiograms, no attempt was made to translate thresholds into absolute terms

C *Training* The monkeys were trained by *instrumental avoidance conditioning* techniques That is, they learned that if they gave some response (for example, waving a paw) following the presentation of a tone, they would thereby avoid the shock which would otherwise follow that tone This habit was quite easy to establish and extremely stable once it had been established It was then generalized to include responses to both loud and soft tones with frequencies of 150, 500, 1,000 and 4,000 cycles per second

D *Testing* Once the monkeys were thoroughly trained, it was possible to test their hearing in a manner which followed in most significant details the method described by Harris[5] In determining the threshold for each of the four stimulus frequencies used, a modified form of the psychophysical Method of Limits — the so-called Method of Serial Groups[5]— was utilized The threshold was defined as that intensity at which the animal made his response 50 per cent of the time The monkey was given five trials at each intensity level and was considered to have "passed" a given level if he responded correctly in three or more of the trials For each frequency a descending, ascending, and descending series of trials were given in that order so that the animal's threshold was crossed three times and, therefore, the determination of his absolute intensity limen was made from at least 15 individual tests of his hearing at near liminal intensity The monkey's audiogram for the four frequencies used was in most cases considered valid when four consecutive limens at each frequency (determined on different days) varied by no more than 4 db

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*This apparatus was designed and maintained while he was at Rochester by Prof John D Coakley

E Surgery The operations were carried out while the animals were under deep nembutal anesthesia, and standard aseptic technique was employed throughout. With the exception of a few of the control operations, all operations were performed by the same surgeon * Adequate recovery time was allowed following each operation before the animals' hearing was tested, and nystagmus and indications of infection were checked postoperatively

The experimental deafening of one of the ears was achieved by a simple mastoidectomy and removal of the incus In the early cases the head of the malleus was removed also, but it was soon found more expedient to postpone this step until the time of the fenestration operation.

The control operation was designed to eliminate the functioning of the monkey's other ear, or failing this to render it at least as deaf as the experimental ear The ossicular chain was again interrupted by removal of the incus, and 70 per cent alcohol was injected into the labyrinth through a fistula made in the horizontal semicircular canal Histologic observations of the destruction produced in the inner ear by this procedure will be discussed later

The fenestration operation itself followed fairly closely the technique described by Lempert[7, 8] but postauricular incisions were used exclusively In all cases the incus was absent, and the head of the malleus was removed where it had not been removed previously The fistula was made as far anteriorly as possible and covered with a meatal flap (in several of the operations however, the flap was torn and replaced with a

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Dr Karl Lowy who has worked with Dr Lempert, employed an operative technique almost identical with that used on his human patients. Only minor modifications (such as a postauricular incision) were necessitated by the monkey anatomy skin graft from the back of the auricle), also, in a few cases, a piece of cartilage was inserted into the fistula before covering it In most animals a paraffin plug was used to hold the flap in place In a few cases Gelfoam packing was used

Except in the few cases where absorbable Gelfoam had been used as packing, the fenestrated ear was reoperated approximately seven to 12 days later when the packing or paraffin plug was removed At this time the healing of the flap was noted Since this final operation was invariably bloody, one to two weeks were allowed to elapse before testing the animal's hearing, by then it was assumed that most of the blood had been absorbed

Recovery of the animals from these operations was remarkably rapid Except for a few days following the control operation — where the ear had been assaulted with alcohol — during which the animals showed dizziness, nystagmus, and temporary or permanent torticollis, functional recovery of the animal coincided with recovery from the anesthetic

F Histology When hearing tests had been completed for an animal, its head was perfused with formalin and the temporal bone removed bilaterally These temporal bones were fixed in formalin, decalcified in trichloracetic acid, and embedded in celloidin They were then sectioned at 20 $m\mu$ and mounted on slides Finally they were stained with Masson's trichrome stain * All of the experimental ears and a random sample of the control ears were examined microscopically †

G Statistics The statistical methods for the treatment of small samples described by Fisher[4] were used in treating the data obtained The reliability of all the obtained differences between means of the auditory limens was tested by means of "Student's t" When the probability that the two sample means being compared were drawn from the same population was greater than 0 05, that fact is indicated in our tables by parentheses around the reported difference. When grouping the data, these nonsignificant differences are treated as zero differences.

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*All of the histological processing was performed by Alice Van Krevelen

†All of the slides were examined by Dr Lowy who dictated the descriptions of his findings reported later in this paper

III — RESULTS

A. Hearing Loss Due to Removal of the Incus. This part of the experiment was carried out upon a series of four monkeys of approximately the same age, size, health, and length of sojourn in the laboratory. The left ear of each animal was subjected to the control operation of removing the incus and injecting alcohol into the labyrinth. Then the hearing threshold of the intact right ear was determined for each of the four test frequencies. Following this preoperative determination of thresholds, the incus was removed from the right ear and the animals' limens were determined postoperatively. The average thresholds before and after removal of the incus were calculated, and the difference between them taken as the hearing loss.

Table I shows the monaural hearing thresholds before and after removal of the incus in the experimental ear. Each threshold tabulated is an average of four or more threshold determinations made on successive days within a period of two weeks or less. A mean loss — the difference between the two series of thresholds — was calculated for each frequency. It may be observed that this loss was approximately the same in magnitude for the four frequencies tested. the general average of these four was 11.6 db.

TABLE I.

MONAURAL HEARING THRESHOLDS BEFORE AND AFTER INCUS REMOVAL.

Monkey	Frequency							
	150 cps		500 cps		1 000 cps		1 000 cps	
	before	after	before	after	before	after	before	after
Ermintrude	59.3 db	11.2 db	73.3	18.5	73.5	29.6	76.0	31.5
Agatha	63.2	11.6	70.0	19.5	74.5	30.0	74.4	31.0
Moe	57.0	14.3	68.0	27.6	73.0	36.6	74.0	29.6
Alan	47.7	7.5	59.5	17.5	70.4	26.0	67.5	25.0
Mean	56.8	11.2	67.7	20.8	72.8	30.6	72.9	29.3
Mean Loss	45.6		46.9		42.3		43.7	

B Changes in Hearing Immediately After the Fenestration Operation This part of the experiment was carried out on a series of 19 monkeys over a period of five years These animals were of assorted age, size, sex, and length of sojourn in the laboratory With the exception of two animals who were previously used in Part I, all of the monkeys were first operated upon — the incus removed from the experimental ear, and the other ear deafened by the control operation The animals were then conditioned and a series of limens determined The means of these limens were taken as the monkeys' prefenestration audiogram

At this time the fenestration operation was performed upon the experimental ear Approximately one and one-half weeks after the ear had been reoperated to remove the packing (if nonabsorbable packing had been used), when external examination indicated healing and absorption of blood in the ear, a second set of limens was taken The means of these limens served as the postfenestration audiogram The differences in decibels between these two audiograms were taken as the change in the animals' hearing due to the fenestration operation

Table II shows the amount of hearing change in decibels for each animal In this table the monkeys are grouped according to breadth of their hearing improvement from those who showed improvement at all four frequencies to those who showed improvement at none From this grouping it can be seen that 17, or 89 per cent, of the animals showed a significant improvement in hearing for at least one frequency Only two of the animals who exhibited improvement at some frequencies suffered significant losses at others

Table III shows the data, isolated from Table II, of the four monkeys who showed significant losses following the fenestration operation These animals represent 21 per cent of the total group

Table IV shows the results of treating the data in Table II separately for each frequency It can be seen that the highest percentage of animals made gains at 1,000 cps and the great-

TABLE II.

CHANGES IN HEARING IMMEDIATELY FOLLOWING FENESTRATION OPERATION

(Parentheses indicate a nonsignificant value.)

Monkey	150 cps	500 cps	1 000 cps	4 000 cps
Gains at all four frequencies N 3 15.8%				
Bennie	9.0 db	9.4 db	7.7 db	13.0 db
Mehitabel	5.5	6.5	9.3	8.5
Karmon	8.5	9.3	10.2	8.4
Gains at three frequencies N 7 36.8%				
Joe	6.8	7.5	4.3	(2.0)
Mrs. Adolph	11.5	17.0	8.2	(0.9)
Phineas	2.6	(1.2)	7.7	12.1
Winston	9.5	–4.5	6.5	22.5
Mabel	8.3	(0.4)	10.7	4.0
Muggsy	(3.0)	4.5	3.5	3.5
Donola	(2.0)	7.5	6.0	5.7
Gains at two frequencies N 5 26.3%				
Cleopatra	4.0	8.1	(–0.7)	(1.5)
Clarissa	7.6	(0.8)	(3.0)	5.3
Ivan	(2.0)	4.0	8.4	(2.6)
Angelpuss	–6.7	3.7	–3.3	8.7
Bertram	(–1.5)	(–8.4)	10.3	8.9
Gains at one frequency N 2 10.5%				
Kopeck	4.0	(–2.9)	(–1.5)	(–0.4)
Ermintrude	(–0.2)	(0.2)	10.4	(0.5)
No improvement N 2 10.5%				
Alma	–3.6	0	(3.0)	(1.7)
Agatha	–5.2	(4.2)	0	(0.7)

TABLE III.

SIGNIFICANT LOSSES IN HEARING FOLLOWING FENESTRATION

Monkey	150 cps	500 cps	1 000 cps	4 000 cps
Alma	–3.6 db			
Agatha	–5.2			
Angelpuss	–6.7		–3.3	
Winston		–4.5		

est average gain was recorded at 4,000 cps Since the initial losses at these two higher frequencies were slightly less than those at the lower frequencies, the percentage of hearing restored by the operation was greatest for the two higher frequencies

TABLE IV

STATISTICS FOR THE GROUPS OF ANIMALS SHOWING IMPROVEMENT AT EACH FREQUENCY

	150 cps	500 cps	1 000 cps	4 000 cps
Number of monkeys gaining	11	10	13	11
% of total N (19)	57 9%	52 6%	68 4%	57 9%
Average gain	7 0 db	7 2 db	7 9 db	9 1 db
Average loss (from Results A)	45 6 db	47 0 db	42 3 db	43 7 db
% of loss restored	15 4%	15 3%	18 7%	20 8%

C Duration of Postoperative Hearing Changes Selection of the animals for this part of the experiment was determined primarily by the animals' health In the early design of the experiment it was assumed that the monkeys would be alive so that their hearing might be tested one year after the fenestration, however, only five of the early animals survived until this test could be made * This left many monkeys whose ears were histologically processed after several months had elapsed since their last hearing test To obviate lack of data on hearing just prior to death, periodic testing of the later animals was performed at intervals of two to three months Six animals exhibiting fairly wide variation of immediate postoperative hearing change were available for this periodic retesting

The fluctuations in the monkeys' hearing over the period during which they were being tested produced some interesting data Instead of the expected random variations with a tendency toward leveling off, some of the animals showed distinct trends of hearing improvement at some—but not all—frequencies This improvement trend was not specific to any one frequency, although it was most often absent at 4,000 cps The accompanying graphs (See Fig 1 to 6) show these trends for each of the animals whose data were available. Joe (see Fig 1) shows the most striking improvement

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*Most of the deaths appeared to result from the inability of some of the monkeys to adapt to the caged life of the vivarium

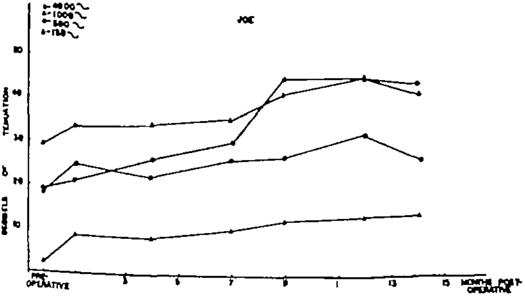

Fig 1

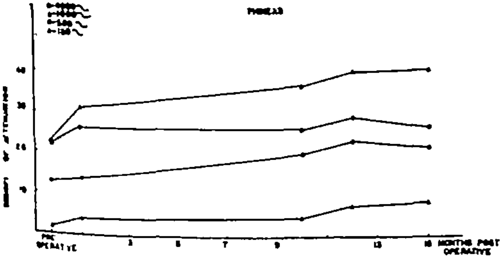

Fig 2.

at all frequencies except 500 cps, Bennie (see Fig 3), on the other hand, shows in general the leveling-off which had been expected and the other animals show specific improvements at various frequencies

For all 11 of the animals in this series the prefenestration audiogram was compared with the final postfenestration audiogram These final data were obtained from nine to 15 months after the fenestration except in the case of Dunois, whose final limens were obtained two years postoperatively The differences between these two sets of limens were computed and tested for significance and are reported in Table V Treating these data in the same way as those of Results Sec-

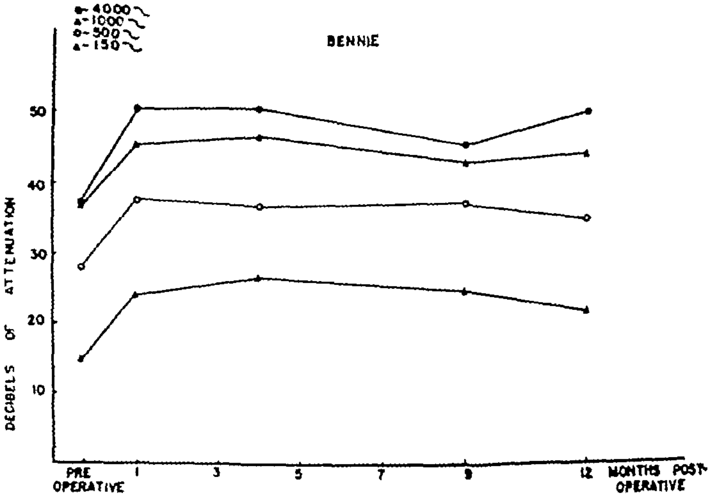

Fig 3

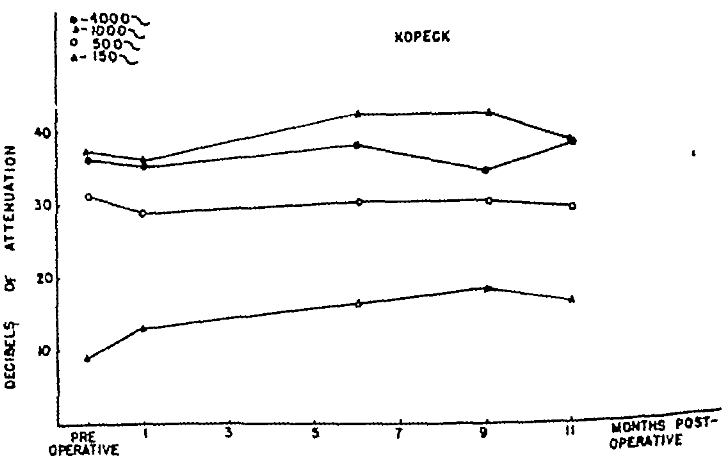

Fig 4

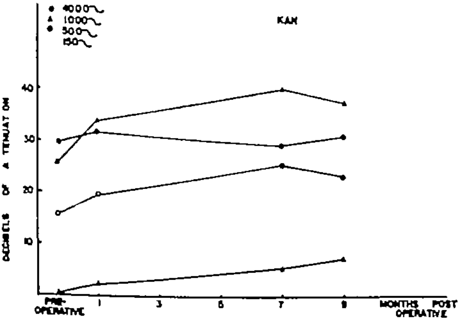

Fig 5

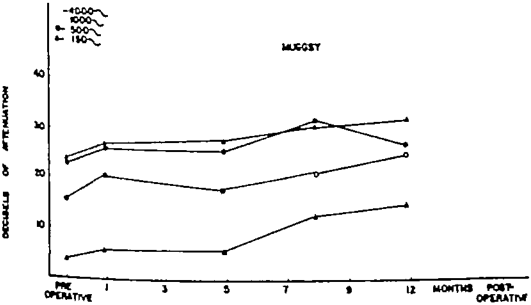

Fig 6

tion B, it is found that nine or 82 per cent, of the monkeys had improved hearing for at least one frequency Only two of the animals who showed improvement exhibited significant losses

Table VI, again treating the data as in Section B, shows the results of dealing with each frequency separately Here the greatest percentage of monkeys showed improvement at 150 and 1 000 cps. The greatest average improvement was at 1,000 cps

TABLE V

CHANGES IN HEARING MAINTAINED AT TIME OF DEATH

Monkey	150 cps	500 cps	1 000 cps	4 000 cps
Gains at all four frequencies N-4, 36 4%				
Bennie	6 3	6 0	5 2	12 3
Joe	12 0	8 7	12 8	25 0
Muggsy	11 3	9 3	8 0	4 3
Phineas	7 0	8 6	18 0	11 3
Gains at three frequencies N 2, 18 2%				
Kan	7 3	7 5	11 4	(2 0)
Cleopatra	2 5	(4 7)	4 6	10 5
Gains at one frequency N-3, 27 3%				
Clarissa	(-1 5)	-6 0	(0 3)	6 3
Kopeck	7 5	(-2 3)	(0 5)	(2 0)
Alma	(2 2)	-6 0	4 0	(2 5)
No improvement N 2, 18 2%				
Dunois	-9 5	-5 0	-6 0	(4 7)
Angelpuss	-8 7	(1 0)	-27 7	-7 3

TABLE VI

STATISTICS FOR THE GROUPS OF ANIMALS SHOWING IMPROVEMENT AT EACH FREQUENCY NINE TO 15 MONTHS POSTOPERATIVELY

	150 cps	500 cps	1 000 cps	4 000 cps
Number of animals gaining	7	5	6	7
% of total N (11)	63 6%	45 4%	54 5%	63 6%
Average gain	7 7 db	8 0 db	10 0 db	9 1 db

D Histologic Examination of the Ears Histologic data were available for 18 of the 19 fenestrated monkeys used in Sections B and C of this experiment The ears of Mrs Adolph were lost, and sections of the posterior part of the fistula were missing from a few of the ears In spite of these drawbacks, the histologic specimens for the majority of the animals were quite satisfactory

In every one of the random sample of control ears which was examined microscopically evidences of labyrinthitis were observed in the cochlear sections In addition to this random sample, the control ears of all animals with marked hearing improvement which did not seem to be accounted for by the histologic condition of the experimental ear were examined In no case was there evidence of a functional cochlea in the control ear

When it was attempted to relate the histologic condition of the experimental ear with the monkey's functional hearing data, the temporal difficulty described in Section C was encountered. Occasionally an animal's rapidly failing health would necessitate dispatching him several months after his hearing had last been tested, however, we were able to dispatch 13 animals immediately following a postoperative limen determination These 13 include the 11 reported in Section C and two additional animals For the remaining animals, their most recent limens were considered in conjunction with their histologic data with due allowance having been made for the time elapsed between the last test and the animal's death

The results of histological examination of the ears made it apparent that no easy generalizations could be made concerning the relationship between the animals functional hearing and the condition of their inner and middle ears No simple parallels as between open fistula and improvement in hearing and closed fistula and no improvement could be found, nor was the converse of this statement borne out by the data Likewise, no evidences of abnormal progressive processes such as cyst formation or adhesions to form functional connections between the disarticulated ossicles were observed in the ear sections of those animals showing progressive hearing improvement

Table VII which contains a brief description of the ear sections of the 13 animals dispatched immediately after a hearing test, enables one to make a comparison of the hearing function with the ear structure and shows the primary result of this study that the structural changes in the ear (such as patency of fistula and thickness of flap) which have been assumed to be associated with improvements and losses in functional hearing do not demonstrate the high correlations that would be expected

TABLE VII

COMPARISON OF FINAL POSTOPERATIVE HEARING WITH STRUCTURE OF EAR

Hearing Gain at	Animal	Operative Technique			Condition of Middle and Inner Ear		
		Flap	Fistula	Packing	Flap	Fistula	Abnormalities
4 freq	Benny	Tympano meatal	Typical	Paraffin	Very thin	Bony closure	Drainage from ear first month postoperative
4 freq	Joe	Plastic	Typical	Paraffin	Heavy with underlying cyst	Obliterated	Perilymphatic part of canal almost filled with bone
4 freq	Muggsy	Tympano meatal	Typical	Paraffin	Thin covering cystic tissue	Completely covered by thin bone	Flap had slipped loose from canal
4 freq	Phineas	Plastic	Typical	Cotton	Good with epithelial masses near fistula	Completely closed	None
3 freq	Kan	Plastic	Typical	Paraffin	Thin	Covered by minimal layer of bone	None
3 freq	Cleopatra	Tympano meatal	Typical	Paraffin	Heavy with cysts	(Not sectioned)	Inflammatory changes in region of flap
1,000 cps	Ermintrude	Tympano meatal	Typical	Gelfoam	Fairly thin	Closed by thin bone	None
1,000 cps	Alma	Tympano meatal	Typical	Paraffin	Heavy with cysts	Completely closed	Bony obstruction of parts of canal
4,000 cps	Clarissa	Plastic	Typical	Paraffin	Thin, well healed	(Not sectioned)	Part of canal occluded by bone
150 cps	Kopeck	Tympano meatal	Typical	Skin graft	Thin, excellent	Closed with thin bone	None
None	Dunois	Tympano meatal	Cartilage stopple	Paraffin	Thin, well formed	Partly open	Stopple in place
None	Angelpuss	Tympano meatal	Typical	Paraffin	Very thick	Occluded	Possible labyrinthitis in cochlea
None	Agatha	Tympano meatal	Typical	Gelfoam	Very thick	Obliterated	Epithelial masses in canal

IV — DISCUSSION

Confronted with these incompatible results from our two methods of investigation—functional and histologic—we are forced to answer the reader's natural question as to the validity of the data themselves Since the design of the experiment did not permit direct evidence, indirect evidence for the validity of the data is presented in the following paragraphs

It is fairly obvious that the interpretation of the microscopic appearance of the ears is valid In most cases the tissues were well preserved and well processed And the phenomena which we sought in examination of the ear sections (*e g* regenerated bone in the fistula condition of the flap, and new connection with the disarticulated stapes to the auditory transmission system) were not ones which might be simulated by artefacts inherent in the histological processing

Evidence that the functional hearing tests were valid is somewhat less obvious All the tests were performed under the direction of the author, which would tend to make them more consistent The fact that some of the animals were tested by other supervised individuals serves as a check upon the reliability of the author's own test results The validity of our testing methods may be indirectly indicated by the similarity of our results to those of Harris[5] When the averages of the normal monaural limens reported in Results Section A of this study are compared to Harris' average binaural limens our limens are roughly 3 to 6 db higher (*i e* poorer), which is the accepted difference between monaural and binaural hearing In addition the hearing losses following removal of the incus did not vary greatly among this series of monkeys and are quite similar to losses after incus removal found by Harris in another series of monkeys[6] Thus it appears safe to assume the validity of the hearing thresholds recorded pre- and postoperatively (see Results Sections A and B)

The progressive hearing improvements reported in Section C of the Results are more difficult to accept. It might be argued that some external physical or psychological factors inherent in the hearing test situation would account for the progressive improvement which we have noted There are the following possibilities

In the first place, one might consider the possibility that deterioration with time (since the tests extended over a period of five years) of the mechanical and electronic parts of the sound and timer systems had slightly changed the frequency or intensity of the tones presented or furnished a click which might have been audible to the animal and served as an additional cue, but, if this were true, all of the animals tested at a given time should have been affected equally with the most recently tested animals having the lowest or the highest limens Since the later monkeys as a group did not have limens appreciably lower or higher than the earlier animals, the possibility of frequency or intensity changes is probably ruled out, and the possibility that the animals responded to an extraneous cue does not satisfactorily account for the variations, both in amount and frequency specificity of the progressive improvements found in each individual animal

It is also possible that the experimenter's criteria for acceptance of the animals' responses may have become more lenient during a five-year period of constant testing This, however, is another factor which would be assumed to apply to all of the animals at all four frequencies, which it did not

Finally, the progressive improvements in the thresholds might be accounted for by the factors inherent in a conditioning situation of the type we have utilized

The immediate postoperative improvements in hearing may have been occasioned by the improvement in performance with practice which occurs in any learned response even though the fenestration was always performed after the animals' preoperative limens had reached a plateau, however, this plateau probably represents the monkey's true limen since some of the monkeys never heard below this preoperative threshold even after the fenestration had been performed

The validity of our limens may also be inferred from the comparisons previously mentioned of our limens with those of Harris, who occasionally took as many as 86 thresholds with his animals before he reached the limit which has been shown to differ not greatly from ours

This possible practice effect might have been cumulative during the series of periodic retests but the day-to-day fluctuations of the animals' limens were not always in a positive direction, also, the nontest intervals — two to three weeks following fenestration and two to three months between the periodic retests — would minimize this possibility On the other hand, the phenomenon which has been described in the conditioning literature as spontaneous recovery from the inhibition of conditioning may have taken place during the period of retesting at intervals,* however the attenuation of the conditioning prior to the interval of rest, which is a necessary condition for this phenomenon, was not observed in our animals.

If we grant that the obtained data are reliable and valid, then we must still seek an explanation for continued hearing improvement which might be either partially or wholly independent of the condition of the fenestra.

A first tentative explanation might be the behavioristic factors of adjustment of the monkey to his deafened condition and increasing attention directed by him to faint auditory stimuli It is difficult to avoid anthropomorphism in evaluating these factors The individual variations among the animals which would be expected with respect to this phenomenon were quite evident but one would expect these generalized attitudes to extend equally to all four frequencies tested, and this occurred in only one animal Postural evidences of increased attention were not sufficiently obvious to engage the experimenter's attention, and it seems too great a jump in the phylogenetic scale to look for analogies between

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[*] See Hull, C. L. Principles of Behavior New York D Appleton Century 1943 p. 300

our monkeys' hearing and the "psychological" improvement found by Silverman *et al*[16] in their study of subjective evaluations of hearing improvement following fenestration

A second possible explanation of our results is in terms of the changes which our operative procedures may have caused either directly or indirectly in the monkeys' auditory transmission systems In the first place, we were not working with otosclerotic ears but with ears having an interrupted ossicular chain Concerning the applicability of the fenestration to an ear with a mobile oval window, Rosenwasser[14] reports a theoretical discussion of the Otosclerotic Study Group, where it was stated that patients with the relatively small hearing loss of 20 to 25 db for the critical speech frequencies have usually only partial fixation of the stapes It had been Rosenwasser's experience that patients with a small loss did not get the large improvement from the fenestration that would theoretically be expected At that time, "Wever attempted an explanation on the basis of phase difference in the transmission of sound waves, which differ if there is a new window made in a patient with a fixed oval window and a movable round window membrane in contrast to the patient with a new window, a *partially fixed* oval window, and a movable round window membrane"[14]

Since all of our animals had entirely mobile oval windows, it was not reasonable to expect any striking improvements in their hearing following fenestration The foregoing explanation seems, therefore, to be refuted by the data of Sections A and B, which showed a fairly large percentage of postfenestration hearing improvements which were occasionally greater than 20 db

A possibly more promising explanation for our results in terms of the physical characteristics of the auditory transmission system is suggested by Bekesy,[1] who measured in cadavers with missing middle ear apparatus and a model of the ear the differences in sound pressure between the round and oval windows and the artificial window of fenestration He found that these pressure differences were affected by sound absorption and resonance in the middle ear This middle ear absorption differed greatly in individuals because of differential pneumatization of the mastoid bone and also because of the irregular form and many niches of the middle ear cavity, whose characteristics could be greatly altered by the surgery preliminary to fenestration He also found "in several preparations the differential sound pressure between the round window and an artificial opening at the ampulla of the horizontal canal is of the same order of magnitude as the sound pressure in the auditory canal In this way a total hearing loss of only 30 db arises as against the normal ear Thus in these cases, the fenestra is a fair substitute for a functioning middle ear "[1, p 316] If we can apply this explanation to the immediate hearing improvements found in our animals (Results Section B), we even find a rough approximation of his 30 db total loss, for our monkeys averaged close to a 10 db gain following an initial 40 db loss

We must also attempt to account for the progressive hearing changes reported in Results Section C Comparable data concerning progressive postfenestration hearing changes in humans have been reported by Meurman [13] Taking audiograms at intervals over a period of either 300 or 700 days, he was able to describe five distinct courses of postfenestration hearing changes which were similar to the changes found in our animals He offers no explanation for these phenomena but mentions that 20 of his patients were exceptions to the 'open fistula — improved hearing" rule and its converse Basing an explanation again on inferences from Békésy's[1] report we can suggest that the natural processes of regenerating bone and tissue repair, proceeding after the fenestration may have in some way *gradually* changed the physical characteristics of the middle ear cavity altering the sound system in a manner which might vary with frequency and thus alter the functional hearing of the animals in the ways which we have reported

These explanations might be simply tested by fenestrating monkeys and systematically varying the size of the enlargement of the middle ear cavity and one might find some clarification of the progressive changes with an electrical study (as in the study by Lowy[12]) if the auditory potentials could be recorded at various intervals postoperatively

From the foregoing arguments, therefore, it can be argued that, when we accept the data of this research as valid, we are faced with results not easily explained in the light of present knowledge concerning the auditory transmission system and the results of a typical fenestration operation upon this system The hearing improvements we found serve to indicate that the fenestration operation may serve to improve hearing by means more complex than those heretofore credited to it

V SUMMARY

A The monaural hearing thresholds of a series of monkeys were determined both before and after the ossicular chain was interrupted by removal of the incus The hearing losses caused by this operation averaged 44 6 db with little variability for frequencies of 150, 500, 1,000 and 4,000 cycles per second

B A fenestration operation was performed upon the ears from which the incus had been removed and the monaural thresholds were again taken and compared with prefenestration limens From 58 to 68 per cent of 19 animals gained an average of 7 to 9 db at each of the four frequencies tested, but the variability of the postfenestration hearing changes was very great

C Periodic postfenestration audiograms showed progressive changes in both positive and negative directions at some or all of the four frequencies The variability among the animals was again very great

D At time of death, nine to 15 months after the fenestration operation, from 45 to 64 per cent of 11 animals had maintained hearing improvements averaging between 8 and 10 db at each of the four frequencies

E A microscopic examination of sections of the fenestrated ears showed no clear-cut correspondence between ear structure at the operative site and any pattern of functional hearing changes.

F The possibility is suggested that the enlargement of the middle ear cavity at the time of operation and the subsequent regeneration of bone and repair of tissue might account for the changes in hearing recorded

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A DIFFERENCE LIMEN RECRUITMENT TEST AND ITS DIAGNOSTIC SIGNIFICANCE*

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I –INTRODUCTION

The discovery of the recruitment phenomenon has created an entirely new area of study in the clinical evaluation of hearing loss In the decade following Fowler's[1] initial description, recruitment was assumed to be a concomitant feature of all "perceptive" hearing loss,[2] but in 1946 an exhaustive study by de Bruine Altes[3] revealed that the phenomenon was apparently absent in many cases of pure "nerve" impairment The significance of this finding was illuminated in 1948 by the work of Dix, Hallpike and Hood[4] Using the alternate binaural loudness technique, these investigators demonstrated the presence of recruitment in 30 cases of unilateral endolymphatic hydrops, but its absence, or only incomplete presence, in 20 cases of acoustic neuroma On the basis of these findings they concluded that recruitment was present only in lesions of the sensory receptor mechanism (*i e*, hair cells and organ of Corti) They felt, therefore, that the determination of the recruitment phenomenon had practical diagnostic significance in distinguishing between end-organ and retrolabyrinthine lesions

Unfortunately the clinical utilization of these important findings has been hindered by the lack of a simple, easily administered test of recruitment that is not dependent upon audiometric configuration Although the alternate binaural loudness test is the most valid measure of recruitment, it suf-

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*Summary of a Master's Thesis conducted under the direction of Raymond Carhart Ph.D, Department of Otolaryngology and School of Speech Northwestern University

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fers the obvious limitation that it can be employed only where there is a substantial difference in the threshold levels of the two ears

It has been suggested [5,6] however, that the nature of the loudness function in an impaired ear can be indirectly inferred from the differential sensitivity to intensity change exhibited by the ear * Specifically it has been reasoned that an abnormally rapid acceleration in the loudness function should manifest itself in abnormally acute differential sensitivity to intensity change.

Békesy,[7] in 1947 and Lüscher,[8] in 1948, developed effective methods for the measurement of differential sensitivity Recently, Langebeck,[9] Halm [10] and Denes and Naunton[11] have developed variations of these methods

It is with the Lüscher method that this study is particularly concerned Because it requires a minimum of special equipment, and can be easily and quickly administered the Lüscher method seems to offer the most promising possibilities as a routine clinical test. Lüscher has incorporated into the circuit of an ordinary audiometer a modulating device which produces a loudness beat by varying the intensity of the pure tone periodically

According to Lüscher's own technique the difference limen is measured at a sensation level of 40 db He defines the difference limen as the average value between the points where the beat is just noticeable and just no longer noticeable Recruitment is said to be present if the difference limen is abnormally small

By the clinical application of his simplified test, Lüscher has been able to test the hypothesis of Dix, Hallpike and Hood over a greater variety of clinical types His results not only

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Differential sensitivity refers to the ear's ability to discriminate changes in intensity The unit of differential sensitivity is the difference limen It is defined as that increment in the physical intensity of a sound which a subject perceives as a change in loudness just 50 per cent of the time.

substantiate but further extend their conclusions Luscher has summarized his findings as follows

> The difference limen and the recruitment phenomenon may be regarded from the topical diagnostic point of view as being equivalent the difference limen appears to be dependent upon the function of the peripheral receptors, *i e*, the sensory cells An impairment of the difference limen indicates damage to the organ of Corti and thus allows peripheral disorders of the neural apparatus to be recognized According to our experiences so far, the difference limen permits us to divide disorders of the neural apparatus into three groups
>
> *1* Disorders of the peripheral receptor, *i e*, the sensory cells of the organ of Corti, which decrease in the difference limen
>
> *2* Retrolabyrinthine organic disorders with normal difference limen
>
> *3* Psychogenic hearing disorders with a high difference limen*

In an effort to establish the validity of this test as a measure of recruitment, Neuberger[12] tested 14 unilateral loss cases by both the Luscher and the alternate binaural loudness methods He found a complete qualitative parallelism between the recruitment phenomenon and a decreased difference limen, and concluded that either measure was sufficiently exact for functional diagnostic purposes

II – PURPOSE OF THE PRESENT STUDY

The purpose of the present study was twofold first, to determine whether a modified version of Lüscher's technique would yield results consistent with his original findings, second, to extend the exploration over a greater number of cases, including etiological types not included in his original results

Preliminary investigation of the Luscher technique by the author suggested that its clinical utility might be enhanced by two major revisions *1* changing the sensation level at which the difference limen is measured, and *2* simplifying the procedure of test administration

The 40 db test level has theoretical as well as practical limitations Doerfler's[13] results show that the difference limen in the perceptively deafened ear is abnormally decreased to the greatest degree in the range from 10 to 30 db, but at the

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*E Lüscher 'The Difference Limen of Intensity Variations of Pure Tones and Its Diagnostic Significance Jour Laryngol. and Otol, 65 7 July, 1951 p 510

40 db level it is less significantly differentiated from the normal value It seemed advisable, therefore, to test at a level in the range from 10 to 30 db, furthermore, Békesy,[7] Reger,[14] Fowler [15] and others believe that the greatest degree of recruitment occurs just at and above threshold For these reasons it appeared that a test level as close to threshold as possible would yield the most definitive results Accordingly a preliminary survey was conducted to determine the optimum test level It was found that levels below 15 db were too low for accurate judgment by normal hearing subjects, therefore, 15 db was chosen as the sensation level at which to test.

A preliminary survey of Lüscher's actual testing technique suggested that the method was also clinically cumbersome and frequently indefinitive Specifically, the introduction of modulation through the use of an interrupter switch seemed to confuse the patient and add to the variability of results Consequently this feature of the technique was dropped A major part of the difficulty, however, appeared to be associated with Lüscher's descending method of stimulus presentation. The progression from maximum modulation to less and finally no modulation seemed to cause the beat to perseverate in the subject's awareness Many subjects reported the presence of the beat when no modulation was present at all It was found that an ascending method of stimulus presentation, with progression from no modulation to full modulation facilitated the measurement of the difference limen. In this method the difference limen is defined as the increment in intensity which is just noticeable as a beat.

Thus the original Lüscher method was modified in three ways first, the test level was changed from 40 to 15 db, second, the interruption of the stimulus was dropped, third, the ascending method of stimulus presentation was employed

III – GENERAL TEST PROCEDURE

Equipment A commercially available Amplivox Recruitment Test Set, consisting of a simple amplitude modulator calibrated in decibels of modulation, was incorporated in the circuit of an ADC 50E audiometer The set allowed the introduction of an intensity beat, free of transients into the output of the audiometer The degree of modulation in the beat could be varied continuously from 0 to 5 db and could be read accurately to 0 1 db

Procedure With the ascending method as a frame of reference, the following general test procedure was devised and applied to all cases The subject's audiogram was first obtained He was then instructed in the following manner

> "Now we are going to do another kind of test. You will hear the tone all the time but it will change like this (modulation gradually introduced, then removed) Now it is a steady tone, right? (When subject replies affirmatively modulation is gradually reintroduced) Now it is gradually changing into a beating tone Do you hear the beating tone now? (When subject replies affirmatively modulation is removed) All right, this is what we will do First you will hear the steady tone Then I will gradually change it into a beating tone Raise your finger when you *first* hear the beat. As soon as you signal, I will take the beat out, and we will do it over again We will try it three or four times to make sure we don't make any mistakes Now let's try one just for practice"

The importance of careful instruction to the patient in this test cannot be overemphasized Unless the patient understands exactly what is expected of him, the measures obtained are meaningless Like many other psychological tests, the task must be carefully structured for the patient if meaningful responses are sought

The subject was given one or two practice trials to familiarize him with the judgment he was to make Then the actual test was commenced The hearing loss dial of the audiometer was set to exceed the threshold at the frequency being tested by 15 db, then, with the tone on continuously, modulation was gradually introduced at the rate of approximately 1 9 seconds per 1 db, until the subject signalled the appearance of the beat Three or four trials were made at each frequency The mean value of the trials was taken as the difference limen, or "DL," for that frequency Frequencies were tested in the order 1,000, 2,000, 4,000, 500 and 250 c p s , so as to maintain consistency with common audiometric procedure

In order to clearly differentiate this method of test administration from Luscher's more complex technique, it will be hereafter referred to as the "Northwestern DL Test"*

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*Thus "DL" subsequently refers to the difference limen for intensity change as defined by the method outlined above and the phrase Northwestern DL Test refers to the general test procedure.

IV – STANDARDIZATION

In order to establish normative data with which to evaluate results obtained on hearing loss cases, DLs were obtained on 39 normal ears Each ear was tested at the five frequencies 250, 500, 1,000, 2 000, 4,000 c.p s , at the 15 db sensation level The average DL and its standard deviation for each frequency is shown in Table 1

TABLE 1.
AVERAGE DL AND STANDARD DEVIATION YIELDED BY 39 NORMAL EARS AT EACH FREQUENCY FOR THE 15 DB SENSATION LEVEL.

Frequency	250	500	1 000	2 000	4 000
Average DL	2 0	1 8	1 7	1 7	1.6
Standard Deviation	.38	41	41	35	40

In order to facilitate the interpretation of results obtained on hearing loss cases it seemed desirable to translate the normative data into a form or chart on which clinical results could be recorded graphically for rapid evaluation Accordingly a chart was prepared The chart is reproduced in Fig 1 The test frequency is represented on the horizontal dimension and DL size, in db, along the vertical scale The average DLs for normals at the various frequencies are shown by the heavy solid line running across the center of the chart. The broken lines on either side are separated by two standard deviations from the line showing the average normal values The two broken lines thus enclose an area of four standard deviations This range of four standard deviations was arbitrarily taken as the area in which normal DLs were to be expected The choice of this range of four standard deviations was strengthened by the fact that all the original DLs from the normal hearing group fell within the area The chart is called the "Intensity DL Record" It is used to plot the DLs yielded by a clinical case The procedure is similar to the one employed in drawing an audiometric curve The DL at a particular frequency is recorded on the chart as an X for the left ear and a 0 for the right ear These points thus drawn are then joined by line segments For purposes of illustration, Fig 1 includes a typical clinical record The results were obtained on an ear with marked recruitment which was diagnosed as having hearing loss due to endolymphatic hydrops

INTENSITY DL RECORD
NORTHWESTERN UNIVERSITY
Hearing Clinic

Name ______________________________ Date ______________

Test By ____________________________ Aud Used ______________

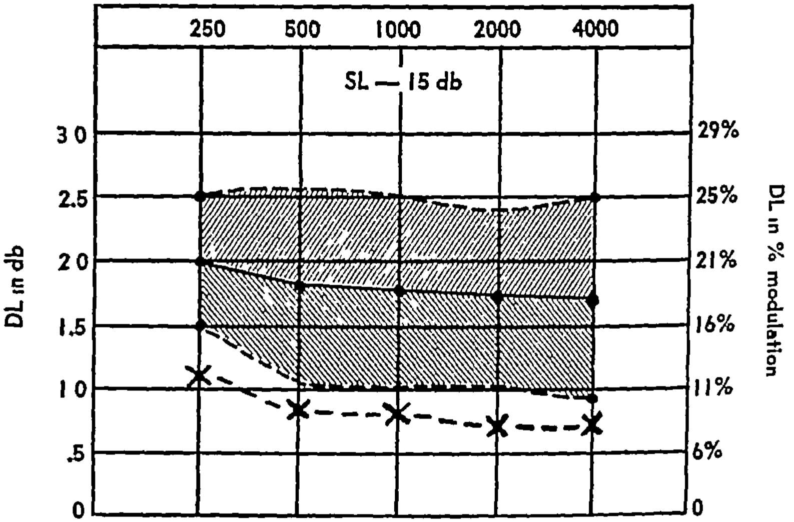

Fig 1 Chart for recording results of DL Test when administered at a sensation level of 15 db Average value for normal DLs (●———●) limits of normal DLs (- - - -) a clinical case of endolymphatic hydrops illustrating abnormally small DLs (X - - - X)

V – EXPERIMENTAL FINDINGS

In order to determine whether the Northwestern DL Test would yield results consistent with Luscher's original findings, the test was administered to 89 hearing loss patients over a period of approximately one year

Each case was diagnosed by an otologist either prior or subsequent to administration of the test In no case did the

DL Test results influence the otological diagnosis Diagnoses have been divided into three categories definite, probable and suspected, according to their degree of certainty *

The 89 hearing loss cases were divided into two groups on the basis of the otological diagnosis One group was composed of those cases in which the otological diagnosis indicated a pure conductive loss The second group consisted of the remainder of the cases, *i.e*, those in which the otological diagnosis indicated a sensori neural component.

In analyzing the experimental data, DLs were interpreted as normal if they fell within the "normal" area of the DL Record, but abnormally small or abnormally large if they fell below or above that area respectively This analysis applied to the majority of cases tested As the experiment progressed however, it became apparent that a small number of subjects particularly those of advanced age, yielded results inconsistent with the above analysis Their DL curves showed the expected configurations, but the curves as a whole seemed to be displaced upward, suggesting slightly larger normal DLs than the average value For example, a case with normal hearing at 1,000 c.p.s and a 50 db loss at 2 000 c.p s showed DLs of 2.4 at 1,000 and 1 1 at 2,000 c.p s Although the DL of 1 1 failed to fall below the "normal" area of the DL Record, it was clearly abnormally reduced relative to the DL at 1 000 c.p s In such cases it was decided that a DL would be interpreted as abnormally small if it deviated from the trend of the DLs which the subject obtained at other frequencies by an amount exceeding the two standard deviation distance for normals at its frequency Similarly, in cases of unilateral loss, DLs on the impaired ear were interpreted as abnormally small if they fell below the DLs for the normal ear by the two standard deviation distance, regardless of the position of the DLs on the DL Record As stated above, this interpretation applied to only a few cases

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*The majority of diagnoses were made by Dr G E Shambaugh, Jr., Department of Otolaryngology Northwestern Medical School, to whom the writer is further indebted for helpful suggestions throughout the study

RESULTS

Fifteen cases comprised the pure conductive loss group. The etiological breakdown was as follows: seven otosclerosis, five otitis media, one perforated tympanic membrane, one probably congenital stapes fixation, one unknown. In no case did the DL at any frequency fall below the "normal" area of the DL Record. The average DLs at each frequency are shown in Table 2, where the values for normal hearers are repeated for comparative purposes. The parallelism of these results demonstrates that at equivalent sensation levels the DL was normal in pure conductive hearing loss. This finding indirectly supports the hypothesis that the recruitment phenomenon and DL size are related. Since a pure conductive loss merely attenuates the energy of the sound wave as it passes through the middle ear into the labyrinth, the loudness recruitment phenomenon should not be present in such cases. This is exactly the situation which was found to exist in the pure conductive loss group.

The remaining 74 cases comprised the sensori-neural loss group. Included in this group were all cases showing a sensori-neural component whether there was a conductive component or not. The DLs exhibited by these cases, at the frequencies at which there was a sensori-neural component, could be divided into three categories

a Abnormally small DLs

b Normal DLs

c Abnormally large DLs

Table 2 shows the average DL at each frequency for each one of these categories, as well as the average DLs for the pure conductive loss group and for normal hearers.

Tables 3, 4 and 5 show the etiological classifications, and the number of cases in each classification, falling under each of the three categories of DL size exhibited by the sensori-neural loss group. The number of cases in each etiological classification is further subdivided into three groups according to the certainty of diagnosis.

TABLE 2

AVERAGE DL AT EACH FREQUENCY FOR NORMAL HEARERS PURE CONDUCTIVE LOSS GROUP AND SENSORI NEURAL LOSS GROUP

Freq.	Norm. Hear	Cond. Loss	Sensori Neural Loss Abnormally Small DL	 Normal DL	 Abnormally Large DL
250	2.0	2.0	1.0	2.0	4.2
500	1.8	2.0	9	1.8	4.2
1,000	1.7	1.9	9	1.8	3.6
2,000	1.7	1.9	9	1.8	4.3
4,000	1.6	1.8	9	1.6	3.3

TABLE 3

NUMBER OF CASES IN EACH ETIOLOGY SHOWING SMALL DIFFERENCE LIMENS CLASSIFIED BY CERTAINTY OF DIAGNOSIS

Etiology	Definite	Probable	Suspected	Total
Acoustic Trauma	3	5	—	8
Endolymphatic Hydrops	6	2	1	9
Hereditary	1	4	—	5
Skull Trauma	—	3	—	3
Otosclerosis with secondary nerve degeneration	13	—	—	13
Meningitis	2	—	—	2
Otitis Media with secondary nerve degeneration	4	—	—	4
Scarlet Fever	2	—	—	2
Influenza	—	1	—	1
Measles	—	1	—	1
Mumps	—	1	—	1
Maternal Rubella in Pregnancy	—	1	—	1
Thrombosis of internal auditory artery	1	—	—	1
Presbyacusis	1	1	—	2
Total				53

Each of the three categories of DL size will now be discussed separately

1 Sensori Neural Losses with Abnormally Small DLs

Table 3 lists the etiological classifications in which the DLs were found to be abnormally small for the frequencies at which there was a sensori neural component The group con-

TABLE 4
NUMBER OF CASES IN EACH ETIOLOGY SHOWING NORMAL DIFFERENCE LIMENS, CLASSIFIED BY CERTAINTY OF DIAGNOSIS

Etiology	Definite	Probable	Suspected	Total
Presbyacusis	4	4	—	8
Streptomycin	1	1	—	2
Cerebellopontine angle lesion	1	1	—	2
Psychogenic	1	—	—	1
Psychogenic Overlay	—	—	1	1
Total				14

TABLE 5
NUMBER OF CASES IN EACH ETIOLOGY SHOWING ABNORMALLY LARGE DIFFERENCE LIMENS CLASSIFIED BY CERTAINTY OF DIAGNOSIS

Etiology	Definite	Probable	Suspected	Total
Psychogenic Overlay	—	—	4	4
Malingering	—	—	1	1
Brain Damage	1	—	1	2
Total				7

sists of eight acoustic trauma losses, nine cases of endolymphatic hydrops, five cases of presumably hereditary loss, three cases of probable skull trauma, 13 cases of otosclerosis with secondary nerve degeneration, two losses from meningitis, four cases of otitis media with secondary nerve degeneration, two scarlet fever losses, two cases of presbyacusis, one case of nerve deafness from influenza, measles, mumps, and maternal rubella in pregnancy, and one vascular lesion of the cochlea

These findings are in agreement with Luscher's report that the DL is abnormally small in acoustic trauma, Menière's disease and endogenous deafness In addition, they include other etiological types not included in Lüscher's original results

The findings reported in Table 3 have important clinical and theoretical implications For example, the apparent presence of reduced DLs in nerve loss secondary to otosclerosis suggests a method for estimating the cochlear reserve of the otosclerotic. Information on this question is an important consideration in prognosis for the fenestration operation. The level of the bone threshold in otosclerosis is not an adequate index of cochlear function because of the mechanical shift in bone acuity occasioned by the immobilization of the oval window (the "Carhart Notch"), but if the 13 otosclerotic cases reported in Table 3 are typical, the presence of an abnormally small DL apparently indicates cochlear invasion which could have been estimated without recourse to the bone conduction measurements

From the theoretical standpoint, detailed knowledge of the nature of the pathological lesion in many clinical conditions has been hampered by the inability to perform detailed histological investigation of human subjects at autopsy For example, in a recent review of the literature on hereditary deafness, Kinney[14] found only one report of a human subject with histological correlates in this country The vast bulk of our knowledge of hearing loss due to heredity, toxic invasion of the cochlea, etc., has, of necessity, come from animal experimentation, but by testing for the recruitment phenomenon it may be possible to infer the locus of pathology in the living subject thus adding significantly to the understanding of auditory impairment.

2 Sensori Neural Losses with Normal DLs

Table 4 lists the etiological classifications in which the DLs were found to be normal The group consists of eight cases of presbyacusis, two cases of streptomycin damage two cases of cerebellopontine angle lesion, one case of psychogenic loss, and one case of suspected psychogenic overlay

These findings are in agreement with Lüscher's report of normal DLs in cerebellopontine angle tumor streptomycin damage, and disorders of the central nervous system

The number of presbyacusics observed to have normal DLs is sufficiently large to warrant special comment. Eight of the 10 presbyacusics included in the present study showed normal

DLs, while the other two had abnormally small DLs This finding might be explained in several ways There is always the possibility that the two cases with small DLs represent erroneous diagnoses, but there is also the possibility that there may be more than one kind of presbyacusis A third possibility is that the primary site of pathology may be in the spiral ganglion with variation in the degree of cochlear damage, depending upon the severity of the lesion

At any rate it would appear that recruitment is the exception rather than the rule in presbyacusis if one may judge from the 10 cases we have observed This finding has important implications for the fitting of hearing aids on these cases It has been commonly observed that presbyacusics often present serious tolerance problems for loud sounds in hearing aid use This has been inferentially attributed to the recruitment phenomenon Limitation of maximum power output, and, more recently, compression amplification, have, therefore, been used in an effort to counter the tolerance problem, but the apparent absence of the recruitment phenomenon in most presbyacusics suggests that the nature of the tolerance problem is not yet fully understood If it is a central rather than peripheral phenomenon, our present methods of handling the problem may be entirely inadequate

The apparent absence of recruitment in the cerebellopontine angle lesion cases has obvious implications in the differential diagnosis of this condition, especially in the early stages

3 Sensori-Neural Losses with Abnormally Large DLs

Table 5 shows that in seven cases the DLs were abnormally large Four of these cases were suspected psychogenic overlay, one was a suspected malingerer, and two were cases of central nervous system damage Because of the small sample size and the absence of neuropsychiatric evaluation of these patients, specific conclusions are not warranted It is significant, however, that in the application of the DL Test to a wide variety of cases a limited number showed atypical responses in the form of abnormally large difference limens Whenever this occurred there was sufficient concomitant evidence to lead to the tentative conclusion that the patient's apparent hearing loss was not on a peripheral organic basis.

Generalizations based on this finding must await further controlled exploration At the present writing it can only be stated that abnormally large differential sensitivity to intensity change apparently does not fit the total clinical picture of peripheral organic involvement of the auditory mechanism.

Summary of Clinical Findings

It is apparent from the data reported above that the relationship between sensori-neural hearing loss and the recruitment phenomenon is more complicated than has previously been supposed Our findings show that in pure conductive hearing loss the DL is normal, indicating the absence of recruitment, but in sensori-neural loss the DL may be abnormally small, indicating recruitment, or normal, indicating the absence of recruitment A small number of cases tested showed abnormally large difference limens In each one of these cases there was sufficient concomitant evidence to lead to the tentative conclusion that the patient s apparent hearing loss was not on a peripheral organic basis No specific conclusions regarding this apparent relationship are herein drawn.

Validation of the DL Test as a Measure of Recruitment

In order to demonstrate that the DL Test is a valid test of recruitment, the alternate binaural loudness test was administered in addition to the DL Test wherever possible. It was reasoned that if reduced DLs were a concomitant feature of the recruitment phenomenon, then the two tests should yield equivalent results It was possible to apply both tests to nine of the cases in the sensori neural loss group In all cases the two explorations yielded equivalent results This finding was interpreted as further substantiation of the parallelism of abnormally small DLs and the recruitment phenomenon

Clinical Utility of the DL Test

During the period of approximately one year that the DL Test has been routinely administered in the two Northwestern University Hearing Clinics, its clinical significance for otologic practice has become evident in a number of areas

Practical applications of the test as an index of cochlear function in the otosclerotic, and as an aid in the differential diagnosis of retrolabyrinthine losses have been described above

In general, the value of the DL Test lies in its capacity to facilitate diagnosis by adding confirmatory evidence in difficult cases For example, the otologist is often confronted with unilateral perceptive loss cases in which the history and standard test findings fail to differentiate between etiologies yielding similar audiometric configurations, as, for example, acoustic neuroma and endolymphatic hydrops In such cases the DL Test effectively differentiates the two etiologies It has been our experience that hydrops cases show sharp, consistent responses to abnormally small changes in intensity of the order of 0 8 to 0 9 db, but acoustic neuroma cases do not respond to intensity changes until they reach the normal value of 1 6 to 2 0 db There is both a quantitative and qualitative difference in the test results Not only are the DLs in the hydrops cases smaller than normal, but the subject's responses are sharper, more consistent, less variable than the DLs in the neuroma cases

VI – SUMMARY AND CONCLUSIONS

The Northwestern DL Test, a simplified revision of the Luscher difference limen test for recruitment, was first standardized on 39 normal ears, then administered to 89 hearing loss cases of varied etiology Pure conductive losses showed normal DLs, but in sensori-neural losses DLs were abnormally reduced in some cases, normal in others, and abnormally large in still others Examination of the etiological classifications falling under each of these categories suggests the following conclusions

1 The Northwestern DL Test yields results consistent with Lüscher's more complex technique This fact leads to the conclusion that the new technique is clinically preferable, since it allows the test to be administered to a greater range of hearing loss cases (The Lüscher technique cannot be used if the loss by air conduction is greater than 60 db)

2 DLs were found to be abnormally small in those etiological classifications in which histopathological evidence suggests damage to the sensory receptor mechanism, *e g*, acoustic trauma and endolymphatic hydrops This fact leads to the conclusion that DLs are abnormally small in end organ damage.

3 DLs were found to be normal in hearing loss due to lesions of the cerebellopontine angle. This fact leads to the conclusion that differential sensitivity to intensity change is normal in retrolabyrinthine lesions.

4 Abnormally poor differential sensitivity to intensity change apparently does not fit the clinical picture of simple peripheral involvement of the auditory mechanism This finding emphasizes the fact that in the administration of the DL Test the clinician must be alert to the possibility of atypical results.

5 DL Test results and alternate binaural loudness test results were equivalent in all cases tested We may conclude, therefore, that abnormally acute differential sensitivity to intensity change is an inherent feature of the loudness recruitment phenomenon

6 Application of the DL Test to a wide variety of clinical cases suggests that the test, as a measure of recruitment, has important implications both as a clinical and laboratory tool

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A CLINICAL AND RESEARCH VERSION OF THE BEKESY AUDIOMETER *

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In 1947, Bekesy[1] described a new type of a continuously variable-frequency, self-testing, automatic-recording audiometer which obviously possesses several features of outstanding merit. This audiometer consists essentially of *1* a continuously variable audiofrequency generator, the frequency of which is varied over the desired part of the frequency spectrum by means of a motor drive, *2* an instantly reversible motor-driven attenuator by means of which the intensity of the test tones can be increased or decreased as desired with a contact key, and *3* a recording pen which indicates the intensity level of the attenuator on the Y axis (ordinate) of an audiogram blank which is moved along its X axis (abscissa) in synchronization with the change in frequency of the continuously variable audiofrequency generator

The listener automatically records his threshold acuity by alternately pressing a key until the tone is just perceived and releasing the key until the tone is just inaudible, while the frequency is varied slowly over the test frequency range by the motor drive (The key can be connected so that the listener can be instructed to press the key only as long as the test tones can be heard) This procedure not only measures the threshold intensity value but also gives an indication of the intensity difference limen at or near the threshold level, which inherently demonstrates the presence or absence of recruitment at threshold in the pathological ear Bekesy points out that since in this audiometer the test tone is always in the vicinity of the threshold little time is lost in the presentation of subliminal stimuli

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In addition to these features, the Bekesy audiometer appealed to the writer because of an interest in "objective" and standardized audiometry[2] With this audiometer the testing skill of the examiner is limited to instructing the patient how to take the test and to adjusting the instrument's controls — operations which can be performed satisfactorily by any novice in audiometry The audiometer also appears to be a superior research and teaching tool for the study of certain hearing problems, some of which will be mentioned later These considerations proved to be sufficiently motivating to induce the writer to attempt the construction of a Bekesy Audiometer * The resulting instrument has proved exceedingly satisfactory, and the early experimental and clinical results sufficiently encouraging to warrant a report on the construction details and research and clinical possibilities of the instrument at the present time

PERFORMANCE CHARACTERISTICS

The new instrument bears very little physical resemblance to the photograph of the original Bekesy Audiometer (not shown in the present paper), which was a laboratory model devised by Bekesy to test the practicability of his new concept for testing auditory acuity

Fig 1 shows the appearance of the instrument constructed by the writer The continuously variable audiofrequency generator on top of the cabinet is a General Radio Co (Cambridge, Mass) type No 1304-A Beat Frequency Oscillator The frequency change of this particular oscillator is a logarithmic function per degree rotation of the frequency control dial above 100 cycles per second The output level meter under the left end of the oscillator provides an instantaneous check on the output intensity level of the oscillator whenever desired The audiogram blank is clipped on a flat audiogram carriage board which is driven from right to left in synchronization with the rotation of the frequency control dial of the oscillator The instrument illustrated can be used to

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*The author was ably assisted in the construction of the instrument by Mr Floyd L. Rinehart electronic technician in the Department of Otolaryngology test the acuity over any five consecutive octaves between 100 and 20,000 cycles per second The audiogram carriage board is geared to move a distance of 28 mm per octave at any one of three different testing time intervals — one minute, two minutes or four minutes per octave This enables the acuity to be tested over the significant five-octave frequency range of 250 to 8 000 cycles per second in five, 10 or 20 minutes as desired A special gear shift control permits a secondary reduction in the rate of the frequency change of the oscillator by a factor of five, thereby permitting any desired octave interval to be spread out over the space and time ordinarily occupied by five octaves This permits a detailed study of sudden and marked acuity changes that occur within relatively narrow frequency ranges or intervals

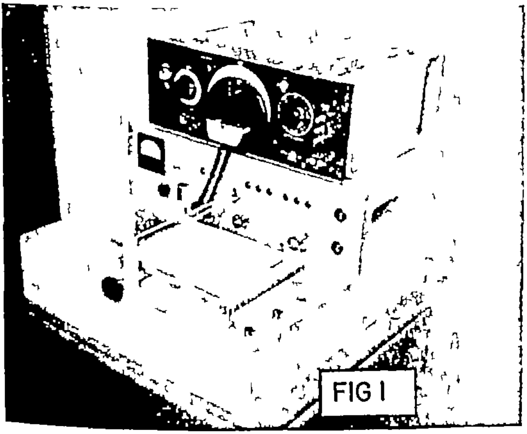
FIG I

The instantly reversible motor drive to the attenuator is geared to attenuate the signal at the rate of 2 1 or 0 5 db per second as desired A maximum attenuation of 2 100 db per octave can be obtained by using a combination of the octave spread feature, the longest testing time (20 minutes) and the maximum signal attenuation (2 db per second) Almost any desired combination of frequency range, testing time, attenuation in decibels per second, and size and shape of audiogram blank can be obtained by selection of appropriate gear ratios and other mechanical parts when the audiometer is constructed

Since it is assumed that the clinician will be little interested in the mechanical construction details of the instrument, these data will be presented in the latter part of the article, however, one mechanical detail simplifies and facilitates so many of the features of the new Bekesy-Type Audiometer that a general description of the part and its function are given immediately below

The "thing" in question is a one-foot length of pinion wire, which is an elongated 16-tooth gear, two-thirds of an inch in diameter The knob on the front and center of the audiometer is attached to the proximal end of the pinion wire (see Fig 1) This pinion wire may be motor-driven at any one of three revolutions rates or may be rotated by hand if desired A spur gear on the distal end of the pinion wire (behind the control panel) engages the mechanism which drives the oscillator frequency control dial The pinion wire also propels the audiogram carriage board by contact between the teeth of the pinion and the teeth of racks along the front and back edges of the board The rotation of the pinion wire, therefore, mechanically synchronizes the rate of frequency change of the oscillator and the speed with which the audiogram carriage board is moved Calibration of the audiometer so that the theoretically "normal" curve appears as a straight line (at the present time assumed to be at or near the mean distance or range between the extreme excursions of the recording pen) also is accomplished by the driving force of the pinion wire, as described later in the construction details

A gear shift mechanism is mounted on the front panel (just to the right of the pinion wire), by means of which the mechanism which drives the pinion wire can be disengaged or the speed of rotation of the pinion be varied by the motor drive. Disengaging the motor drive to the pinion permits it to be rotated by hand to facilitate resetting the synchronized positions of both the oscillator and the audiogram carriage board to their respective starting points for additional tests The entire acuity test can be given with manual rotation of the pinion wire to decrease the testing time whenever desired. Since rapid changes in acuity occur less frequently at the lower frequency levels, the time required to give the entire test can be shortened by rotating the pinion manually as rapidly as desired, up to a given frequency level at which point the pinion can be rotated slower or the motor drive can be engaged Manual rotation of the pinion also permits rapid measures of acuity at octave and semioctave levels if desired

A reasonably effective flexibility of control is incorporated in the present instrument. The attenuation rate (in decibels per second) can be varied at any time during the test procedure. The slowest rate (0 5 db per second) should be used while measuring recruitment and while testing individuals who have slow reaction times The testing time (or rate of frequency change) can be varied at any instant so that the lower frequencies can be tested rather rapidly (one minute per octave) and the higher frequencies where sudden changes in acuity are most likely to occur, can be tested more slowly (four minutes per octave) The driving mechanism between the pinion wire and the frequency-changing dial of the oscillator can be disengaged and set by hand so that the acuity can be tested at any frequency level for as long as 20 minutes if desired As previously indicated, the octave-spread reduction gear permits the acuity for any single octave to be tested over any one of three different time intervals — five, 10 or 20 minutes — and at any of three different attenuation rates — 2, 1 or 0 5 db per second

CLINICAL APPLICATION

Many of the clinical uses of this unique type of audiometer were mentioned in Bekesy's[1] paper Any other uses that may be suggested by the present writer probably appeared so obvious to Bekesy that he did not consider them worthy of comment, nevertheless, a few of the more common uses and advantages of the instrument will be indicated immediately below, since the original articles in the *Acta Oto-Laryngologica* may not be readily available to those who may be interested in this type of audiometer.

As is apparent, the Bekesy Audiometer threshold acuity test more closely approximates a "standardized" hearing test than does conventional manual audiometry, since the audiometrist has nothing to do with the presentation of the test stimuli after the instructions have been given to the patient and the instrument turned on to start the test. Since the patient's reactions to the test are visible to the audiometrist and also recorded on the audiogram blank, the patient's ability to follow the test instructions (take the test) is soon revealed.

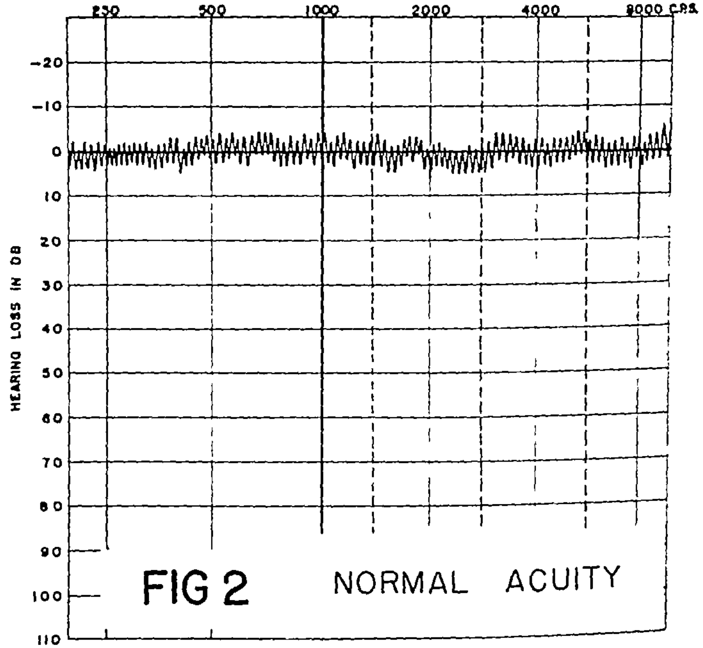

FIG 2 NORMAL ACUITY

Fig 2 shows an audiogram of a "normal" ear of a 20-year-old university student. The intensity range at threshold—the intensity difference between the maximum and minimum levels about the threshold value as indicated by the peak and valley recordings of the up and down excursions of the recording pen — approximates a value of 6 to 8 db This 6 to 8 db "normal" range is also approximated by individuals with middle ear pathologies and by those with "neural" hearing impairments in which recruitment is absent Individuals who exhibit an intensity range twice as great as that of the average normal ear are not capable of taking the test with a desirable degree of accuracy, nevertheless, it is possible that the mean value of the midpoints between the peaks and valleys of wide pen excursions does indicate a usefully accurate threshold value. Many children between eight and nine years of age have been tested who exhibit intensity ranges about threshold of less than 10 db

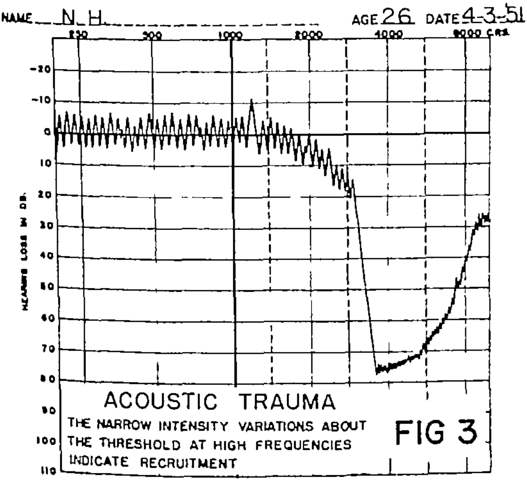

FIG 3

Fig 3 is an audiogram of one ear of an individual with normal acuity for low and a loss for high frequencies The intensity range about the threshold value is "average" over the frequency levels at which the acuity is normal but is markedly reduced at the frequency levels at which the maximum hearing loss exists This reduced intensity range, of course, is due to the fact that the patient experiences a disproportionately rapid increase in loudness as the intensity is raised above the threshold value As pointed out by Bekesy, this method of measuring threshold acuity automatically and inherently demonstrates the presence of recruitment, since the intensity difference limen near the threshold is more acute in individuals who have recruitment This test provides one of the easiest, quickest and most accurate techniques for detecting recruitment No additional time, equipment or confusing instructions or tasks are involved Any child or adult capable of taking the test unknowingly tests himself for recruitment over the test frequency range The test can be applied to all types of hearing impairments, including unilateral, bilaterally symmetrical high frequency losses and bilaterally symmetrical flat losses Appropriate masking must be used while testing unilateral impairments It is advisable to use the slowest attenuation speed (0 5 db per second) while testing individuals with recruitment as well as those who have slow reaction times In certain cases with recruitment in which the acuity varies rapidly as the frequency changes it is advisable to ascertain the intensity range at a few constant frequency levels, for example, at 500, 2,000 and 4,000 cycles per second, using the same attenuation rate at each frequency level

Since the instrument is a continuous frequency range audiometer, the characteristics of sudden or abrupt changes in acuity with changes in frequency are revealed by the test The most accurate and detailed measure of extremely abrupt or precipitous changes in acuity is obtained by using a combination of the octave-spread gear reduction drive and the slowest testing time — 20 minutes per octave

The presence of occasional high peaks or spikes in the intensity range usually indicates the frequency or frequencies at which tinnitus is confused with the test tones, thereby indicating the frequency of the tinnitus The instrument can be equipped and calibrated for use with a bone conduction vibrator for obtaining bone conduction acuity measurements if desired

RESEARCH APPLICATIONS

The Bekesy Audiometer is an excellent device for use in any research problem in which the measurement of auditory acuity for pure tones is involved The instrument is peculiarly suited for use in studies in which it is desirable to measure acuity over a continuous frequency range instead of octave or semioctave frequency levels and in problems in which the test tones are presented for relatively long periods of time This audiometer is ideal for measuring acuity under test conditions which alter the threshold sensitivity with time. For example, it is invaluable for studying the factors of attention and 'fatigue' over relatively long intervals, and for studying in detail the rate of recovery of acuity after the ear has been exposed to exceedingly high noise levels, however, several testing features of the "instrument-patient' combination need early investigation. For example, does the correct threshold lie at the midpoint between the extreme intensity range which is recorded by the peaks and valleys of the excursions of the recording pen? What is the effect of practice? What are the effects of different testing times (rates of frequency change) and of different attenuation rates on the range of the intensity variation above and below the correct threshold value?

CONSTRUCTION HINTS

Sufficient descriptive and photographic data are given below to enable a competent mechanical-electrical engineer to construct a Bekesy Audiometer The instrument presents more mechanical than electrical problems. As indicated previously, almost any desired combination of frequency range testing time attenuation rate in decibels per second and size and shape of audiogram blank can be obtained by selection of appropriate gears and other components at the time the audiometer is constructed

The general appearance of the instrument is shown in Fig 1 The chassis is constructed of sheet aluminum and plywood The plywood base is 23 inches wide and 23½ inches deep The front of the base is 5 inches high and the back of the base, which supports the oscillator, is 12½ inches high The control panel, on which the meter and gear shift mechanisms are mounted, is 7½ inches high The audiogram carriage board is 12 inches long and 8½ inches wide

Fig 4 shows some of the detail of the pinion wire gear (24 pitch, 16 teeth), the audiogram carriage board and the recording pen carriage mechanism Twenty-four pitch racks extend along the entire length of the front and back edges of the audiogram carriage board The pen carriage is moved by an endless ladder chain (No 1A) driven by a two-inch pitch diameter sprocket which is attached to the attenuator shaft The diameter of this sprocket and the number of degrees of rotation of the attenuator shaft which produce the desired total attenuation range determine the length of the Y-axis or height of the audiogram blank The proximal end

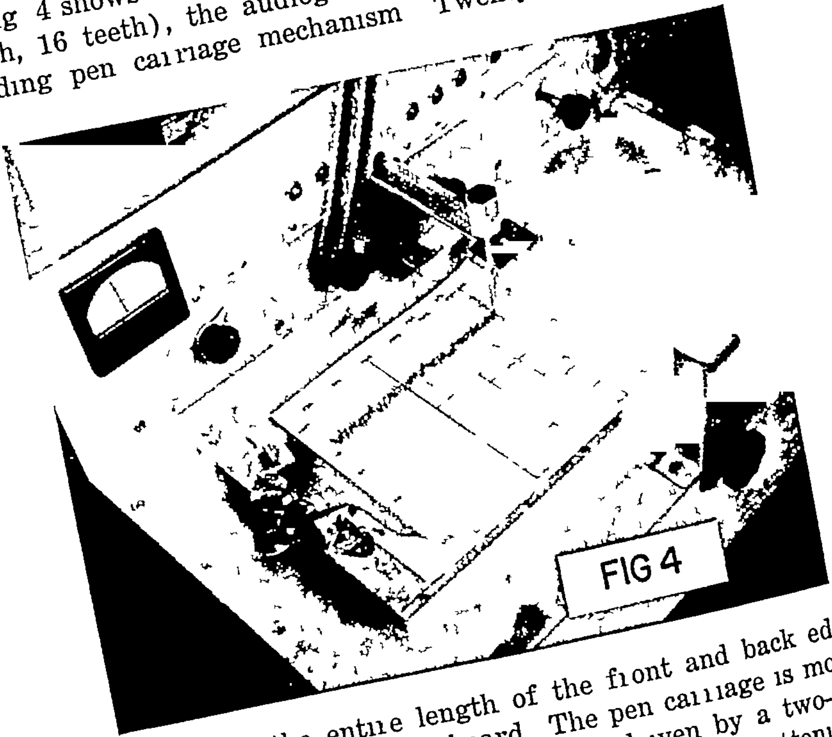

FIG 4

of the ladder chain is supported by a seven teeth idler sprocket. The attenuator in the model illustrated covers a total attenuation range of 140 db in 2 db steps Additional models are being constructed with stepless or continuously variable intensity attenuators. Red and blue ink ball point pens have been found reasonably saatisfactory for use as the recording pens. The hexagonal shaped piece of brass on top of the pen has a hole in the bottom slightly larger than the diameter of the pen filler which fits over the top of the pen to provide sufficient pressure on the point to cause it to record

Two separate but almost identical gear shift mechanisms are used to drive the attenuator and the synchronized oscillator-board carriage mechanism Fig 5 shows a block diagram of the essential features of these mechanisms Shaft S1 is the driver shaft and consists principally of a two-inch length of pinion wire (24 pitch, 16 teeth), gear A S2 is the gear shift idler shaft, which is shifted back and forth to obtain the three different speeds of rotation of the driven shaft, S3 Gear B is a 24 pitch 24 teeth spur gear which is always in mesh with A. All the remaining gears of Fig 5 are 32 pitch spur gears. Gears C and H have 16 teeth, E and F have 24 teeth and G and D have 32 teeth.

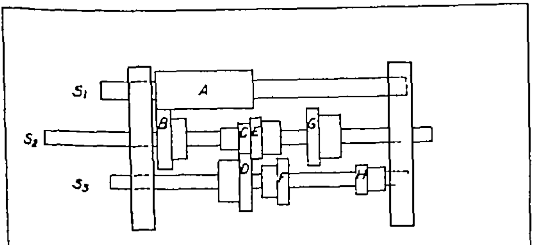

Fig. 5

When S2 is in the position shown, with gears C and D meshed, S3 is driven with the slowest speed, Y. When S2 is positioned so that E and F mesh the speed of rotation of S3 is

2X and when G and H are meshed the speed rotation of S3 is 4X The gears on S2 and S3 are so spaced in relation to each other that S2 has two different neutral positions — positions at which none of the six speed-ratio gears is meshed When the gear shift idler shaft associated with the attenuator is in a neutral position, the attenuator can be rotated manually if desired by means of an extension from the attenuator shaft to the outside of the cabinet When the gear shift idler shaft associated with the oscillator-audiogram carriage board mechanism is in neutral, the position of the audiogram carriage board can be varied or reset manually by means of the knob of the proximal end of the pinion wire

The shafts of the gear assemblies are at right angles to the control panel of the cabinet shown in Fig 1 The two knobs just above the back edge of the audiogram carriage board (see Fig 1) are attached to the gear shift idler shafts These shafts are held in their meshed and neutral positions by means of spring detents which make friction contact with appropriately spaced grooves cut in the circumference of the shafts

Fig 6 is a photographic reproduction of the gear shift mechanisms of a later model than that shown in Fig 1 In the later model the shafts are parallel with the front of the control panel, the lower part of which can be seen on the right side of the photograph P1 and P2 are 12 teeth sprockets, driven by $\frac{1}{4}$-inch No 25 chains to sprockets on the shafts of the motors mounted under the aluminum plate to which the gear mechanisms are attached Gear I, attached to the attenuator shaft, is a 32 pitch, 96 teeth spur gear, driven by a 16 teeth spur gear (H of Fig 5) on shaft S3 of the gear shift mechanism on the left of Fig 6 Only the hub of the sprocket (on the attenuator shaft also) which drives the ladder chain to the pen carriage is visible Only the lower loop of the chain can be seen

In Fig 6 the gear-shift idler shafts are positioned by means of rods R1 and R2, which project through horizontal rectangular openings in the control panel Tension springs

T1 and T2 hold the rods in their desired positions in appropriately spaced slots in the lower borders of the rectangular openings. F1 is the fulcrum of rod R1 and F2 is the fulcrum of R2 M is a rectangular piece of brass rigidly attached at the top to the end of the lever actuated by R2 Shaft S2 extends through a hole in the lower end of M which is held

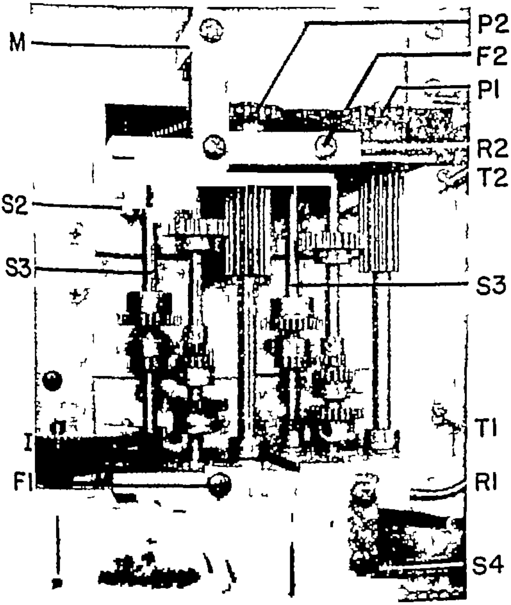

FIG 6

in position on S2 by means of collars on either side of M A similar mechanism positions the gear shift idler shaft on the gear mechanism on the right. Shaft S1 (in the lower right hand corner) is the distal end of the pinion wire which propels the audiogram carriage board The spur gear (32 pitch, 48 teeth) on this end of the pinion wire is concealed by the gear shift mechanism This gear is visible in Fig 7

Fig 7 shows the gear assembly for coordinating the speed of rotation of the pinion wire and the oscillator drive All the gears in this assembly are 32 pitch gears S3 is an extension of the right-hand S3 of Fig 6 B is a bearing to support the end of S3 G1 (16 teeth) and G2 (64 teeth) are bevel gears G2 drives shaft S5, on which are attached G3 (48 teeth) and G4 (16 teeth) The gears on S5 (G4 and G5) drive both the pinion wire which propels the audiogram carriage board and the mechanism which varies the frequency of the oscillator G3 drives the idler G5 (16 teeth), which in turn drives G6 (48 teeth) which is attached to S4, the distal end of the pinion wire G5 may or may not be necessary, depending upon the direction of rotation of the oscillator frequency

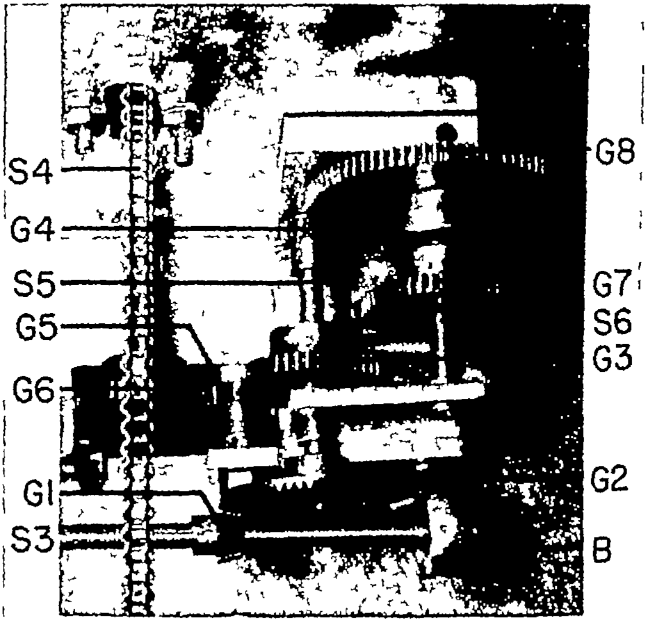

FIG. 7

changing dial to increase the frequency level generated by the oscillator Attached to shaft S6, which drives the oscillator frequency changing mechanism, are G7 (48 teeth) and G8 (80 teeth) The position of S6 can be shifted to obtain either of two rotation speeds or to a neutral position. With G4 and G8 meshed as shown, the slowest speed of rotation of S6 results, which makes possible the octave spread feature When S6 is pushed inward from the control panel as far as possible the speed is increased by a factor of five S6 has a middle neutral position which enables the oscillator to be set at any given frequency level for a test at that level over a time interval as great as 20 minutes if desired When the gear shift idler shaft of the mechanism which drives S3 is in a neutral position (see Fig 6) and G3 is meshed with G7 (see Fig 7), manual rotation of the pinion wire by turning the knob on the proximal end of the pinion wire (see Fig 1) synchronizes the positions of the audiogram blank and the frequency level generated by the oscillator for resetting the instrument to its original starting point or for retesting any part of the test range desired S6 (see Fig 7) is held in any one of its three positions by means of a ball bearing detent and three appropriately spaced V shaped grooves cut in the circumference of the shaft. The hold which can be seen in the top of the bearing plate just over the top of G8 contains a 3/16-inch diameter ball bearing short length of 3/16-inch compression spring and a ¼-inch diameter set screw, which comprise the detent S6 extends through the control panel a sprocket and a knob being attached to this external shaft extension This sprocket and knob can be seen just to the left of the distal end of the pinion wire in Figs 1 and 4 The speed of rotation of S6, the pitch diameter of the sprocket on S6 and the pitch diameter of the driven sprocket and gears on the oscillator frequency changing dial collectively determine the rate of frequency change of the oscillator

The instantly reversible motor which drives the attenuator gear shift mechanism has a shaft speed of 4 r p m in either the clockwise or the counter-clockwise direction. The motor which drives the synchronized oscillator frequency changing and audiogram carriage board mechanisms has a shaft speed of 1 r p m If this motor was of the reversible type the acuity test could be given from the low to the high frequency levels in the conventional manner and then immediately repeated with the frequency decreasing from the high to the low frequency levels if desired

The audiometer is provided with several automatic safety features Each motor is supplied with a separate "ON-OFF" toggle switch A pin extending at right angles from the flat side of the ladder chain sprocket on the attenuator shaft trips either of the two microswitches when the shaft has been rotated to its extreme setting in either direction These microswitches are connected in the electric circuit of the instantly reversible motor so that the direction of the shaft rotation is reversed a few degrees when the limit positions are reached The microswitches also limit the extreme excursion of the recording pen in either direction

A third microswitch is mounted under the top aluminum sheet in such a way that the leaf of the switch extends through the sheet and along the right-hand side of the pinion wire near its middle A piece of angle iron mounted under and near the right end of the audiogram carriage board (see Fig 8) trips the microswitch and stops the motor which drives the pinion wire and oscillator frequency changing dial when the test is completed Two push buttons (see front right-hand corner of Fig 1) also are connected in the instantly reversible motor circuit so that the operator, by pushing the correct button, can cause the intensity level of the tone either to increase or decrease whenever desired, regardless of how the patient is using his signal key These buttons also enable the operator to set the intensity level at the subthreshold or other value before beginning the test

The first step in the calibration procedure is to obtain threshold acuity curves on several theoretically normal ears while the audiogram carriage board is driven in a straight line from right to left To insure the board keeping a constant straight line position, a ball bearing three-eighths of an inch in diameter is mounted on a rigid shaft near the middle and just to the left of the pinion wire (see Fig 8) A rectangular slot having a width slightly greater than the diameter of the ball bearing and a length in excess of the width of the audiogram blank is cut in a metal sheet which is then fastened to the underside of the audiogram carriage board (This straight slot is not shown in any of the illustrations)

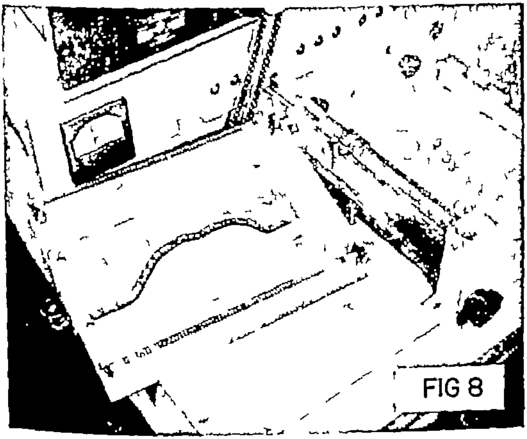

FIG 8

The ball bearing fits into this slot when the board is placed in position on the pinion wire. The "average" or normal' threshold acuity curve obtained with the straight slot is a concave curve (looking at it from the bottom of the audiogram), the exact shape of which is a function of the sensitivity of the ear at different frequency levels the response characteristics of the earphone used for the calibration, and the frequency discrimination (nonlinear distortion) of the oscillator and the attenuator When the shape of the ' average or "normal" threshold acuity curve is determined by use of the straight slot, the slope or contour of this curve is cut in a metal sheet which is then fastened underneath the audiogram carriage board with the convex aspect of the curve presented toward the bottom of the audiogram blank (see Fig 8) The calibrated audiogram carriage board is placed on the pinion wire so that the slot of the curve engages the ball bearing, which exerts sufficient pressure against the slot to force the board to shift along its Y-axis as it is propelled by the pinion wire If the "correction" curve has the correct slope, the mean of the intensity ranges about the threshold will appear on the audiogram as an approximately straight line (see Fig 2) It is advisable to have a board with a straight slot for use in testing recruitment at a fixed frequency level It is possible to fix both a straight and a curved slot on the underside of the same board The pen carriage mechanism can readily be shifted to any position on the chain and tightened firmly at the correct "zero" position after the calibration procedure has been completed (see Figs 1 and 8) The correct spacings on the audiogram blank for the desired frequency abscissae are obtained by clipping a sheet of paper on the audiogram carriage board, meshing the oscillator and pinion wire drives, rotating the pinion wire manually until the oscillator dial indicates the desired frequency levels, and recording with the pen the distances between these frequency abscissae The spacing of the intensity ordinates can be determined accurately by means of a high gain low noise level amplifier and a sensitive vacuum tube a c voltmeter

Bekesy suggests the incorporation of a controlled variable intensity masking noise in the instrument This may be done by synchronizing the rotation of the shafts of the test tone attenuator and the masking noise attenuator so that the intensity of the masking noise increases or decreases as the intensity of the test tone increases or decreases This minimizes the possibility that the intensity level of the masking noise will become sufficiently high to mask or interfere with the acuity of the ear under test due to any "shadow curve" effect of the masking noise Bekesy also describes a method whereby the same attenuator can be used for both the test tone and the noise simultaneously by imposing direct current on the audio current or test tone "The attenuated direct current can then be separated from the audio frequencies by a filter and interrupted to furnish the masking noise"[1]

Permaflux or equivalent or better quality dynamic earphones should be used with the instrument. Microswitches make satisfactory patient signal keys Additional modifications of the component parts will produce desirable improvements in the performance of the instrument An oscillator which can produce a frequency warble of desired characteristics may be preferable to the conventional signal generator A reversible motor drive of the oscillator-pinion wire mechanism will permit the test to be given with either increasing or decreasing frequency change Other calibration mechanisms might be an improvement in certain respects, and other types of drive and speed changing schemes may possess definite advantages The instrument in our clinic is revised quite often

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TREATMENT OF HAY FEVER, VASOMOTOR RHINITIS AND VASOMOTOR SINUSITIS WITH SODIUM PSYLLIATE—900 CASES

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San Jose, Calif

In otolaryngology, allergic conditions are among the most common requiring treatment When the pathologic process involves the nasal mucosa, the accessibility of the latter offers *advantages in treatment not often present in allergic conditions* affecting other portions of the body Submucosal injections of a 5 per cent solution of sodium psylliate intranasally is an effective therapeutic procedure offering certain advantages over other intranasal and other antiallergic treatments at present This report on 900 allergic patients so treated in the past seven years, with follow-up data on 568 (63 per cent) unselected patients may be of interest to those who encounter some of the many manifestations of allergy

Since intranasal vasomotor instability rather than infection is the basis for the symptoms and pathology of nasal allergy, it is suggested that the term vasomotor rhinorrhea is preferable *to that of vasomotor rhinitis The term* hay fever, whether seasonal or perennial, may be used correctly in describing only a proportion of cases of nasal allergy and should be used less freely

The average age of patients treated was 32 2 years, they were seen from the age of one to well in the seventies Nine and four-tenths per cent were less than 10 years of age, 45 per cent were in the third and fourth decades, and there were 8 per cent more males than females

The group treated from 1944 to 1951 comprised 11 4 per cent of all the patients examined Since many did not elect

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to have treatment, it is evident that the incidence of allergy in otolaryngology must be appreciably higher A higher percentage (15 per cent) of patients were treated in May due to the incidence of seasonal allergy, but even in November when the lowest percentage (4 8 per cent) was examined, it was evident that the disorder is principally chronic. The chronicity is further attested by the duration of symptoms because in only 17 per cent of patients had symptoms been noted for less than one year, while 48 9 per cent of patients stated they had had symptoms for from six to 40 years A history of allergy in the family was common.

The patient's clinical history is an important guide to diagnosis and treatment, and symptoms were described in the following order of frequency nasal obstruction, postnasal discharge, nasal discharge, discomfort in the throat, asthma headache usually associated with nasal obstruction, vasomotor symptoms referred to the eye and stuffiness of the ears and other aural symptoms It was surprising to find conduction type of deafness in 16 per cent of cases and asthma in 14 6 per cent of cases Anosmia was common, particularly in more chronic cases The most common symptom, that of nasal obstruction was often associated with sneezing, itching of the nose and watery nasal discharge. Nasal obstruction, though variable, was usually worse indoors and worse when the patient lay down, when it might be alternately on one or the other side of the nose, depending upon the position of the head Not infrequently when there were septal spurs or deviations of the nasal septum with obstruction, both common findings, the patient definitely stated that the more open side of the nose, that is, objectively, gave much more trouble and was much more often obstructed This indicates the importance of vasomotor irritability of the mucosa rather than septal deformities in producing nasal obstruction. On inspection of the nasal mucosa, it was usual to find it to be boggy, pale and swollen enough to produce obstructive symptoms In cases of long standing, polypi were not uncommon Examination of the nasal mucus for eosinophiles showed the average percentage of these to be 9 7 per cent, but their presence could not be considered diagnostic Although nearly all patients had had treatment previously for allergy or treatment or surgery directed to the nose or sinuses, relatively few had previously had Roentgenograms made of their sinuses Of 323, or 35 8 per cent, of those patients receiving treatment, in whom Roentgenograms of the sinuses were made, the findings were positive in 93 per cent, and in 64 9 per cent of the latter there was reported pansinusitis, bilateral antral involvement or involvement of both antra and of both ethmoid groups of sinuses The findings usually consisted of much or moderately thickened mucosa The sphenoids were seldom reported to be involved Irrigations of an antrum or of the antra were performed in 39, or 12 per cent, of the above 323 cases, and in 19 cases pus was obtained Operations on the antrum, however, were done in only eight, or 2 4 per cent, of the 323 cases, *indicating that in spite of positive* Roentgenograms and of the presence of pus in an antrum, surgery is as a rule unnecessary when allergy is the underlying etiological factor It seems more important that the irritated nasal mucosa be treated and in those patients with nasal polypi it seemed that, following their removal, if the nasal mucosa was adequately treated, the recurrence of polypi was often definitely postponed or entirely prevented

The present management of pollen hay fever consisting of environmental control and desensitization seems most difficult and often unsatisfactory Skin testing leaves much to be desired Many of the patients studied had previously tried both forms of treatment The average length of previous treatment with injections of antigens was 2 38 years Those patients who previously had been operated upon or had previously had intranasal cauterization were 13 6 per cent, those operated upon only were 11 per cent of the total The most commonly performed operations done previously were submucous resection of the nasal septum, according to the histories obtained

In the group treated were 84, or 9 3 per cent of the total, had nasal or sinus surgery also, and several surgical procedures were sometimes done on one patient Operations on the sinuses were done 11 times, polypi were removed once in 45 cases, more than once in five cases, and submucous resections were done in 51 cases

In small children there seems no good reason for postponing the removal of infected tonsils and adenoids, but I am sure that too often the tonsils and adenoids are blamed when actually so-called colds, sinusitis, rhinitis, bronchitis and deafness originate on the basis of nasal allergy I have seldom seen adenoids sufficiently hypertrophied to obstruct the nasal passages nor adenoid tissue growing in the Eustachian orifices and causing deafness Allergic swelling of the nasal mucosa with resultant sinus and bronchial pathology is a much more likely cause of trouble than are the adenoids. Treatment directed to correction of the nasal allergy, even the constant use of antihistaminics, is sure to give better results than ill advised surgery on tonsils, adenoids or sinuses

Treatment to relieve the irritated, boggy condition of the nasal mucosa, most often seen over the inferior turbinates, has long been practiced The nerves from the sphenopalatine ganglia, which supply the nose and are responsible for this irritation, have been treated with various sclerosing solutions either injected, as alcohol into the ganglion, or applied topically, as phenol, silver nitrate, trichloracetic acid, to the mucosa over the ganglia. The average duration of relief following the application topically of silver nitrate is nine months. The surgical diathermy needle is used to scarify areas in the boggy mucosa covering the inferior turbinate bones Zinc ionization is another method of producing an intranasal reaction, following which the mucosa and its nerves were less sensitive. Injections of small quantities of soapy solution such as sodium morrhuate have given good results, and since 1910,[1] good results with perhaps less localized reactions were obtained by the injection of a 5 per cent solution of sodium psylliate into any areas of the mucosa which appear swollen and irritated. I have found it necessary in many cases to treat the mucosa of the septum and middle turbinates as well as that of the inferior turbinates Treatment should be conservative and controlled in order to avoid sloughing of the mucosa, and the olfactory areas are to be avoided

The effect of topical application of sclerosing solutions on the nasal mucosa was demonstrated experimentally[2] Silver nitrate solution, 20 per cent, applied to the mucosa in the sphenopalatine area in the nasal passages of rabbits changed both epithelium and nerve fibres, and the regenerated epithelium showed marked cellular infiltration, while the nerve fibres showed this change and also vacuolization

The advantage of the use of sodium psylliate over the other measures mentioned appear to be in the longer periods of relief obtained, and the greater ease in administering the solution than, for example, the use intranasally of the surgical diathermy needle Where the use of sclerosing solutions topically can be avoided, there seems also to be less chance of sloughing of the mucosa The morrhuate solution seemed to produce more swelling and pain than followed the use of sodium psylliate

In allergic children, the injections of sodium psylliate are given with the patient under general anesthesia, not infrequently at the time of removal of tonsils and adenoids, while in adults local anesthesia is adequate for the intranasal procedure, 2 per cent pontocaine being used topically

Extreme care is taken to avoid injecting the solution into a blood vessel In order to minimize the post-treatment discomfort, caused by swelling of the mucosa, the sodium psylliate is usually mixed with 1 to 4 per cent procaine in a proportion of three to four parts psylliate to one part procaine Discomfort following treatment is usually limited to nasal obstruction caused by swelling of the mucosa, but may be associated with swelling of the soft tissues of the nose and lower eyelids Very rarely a temporary shingle-like reaction involved the palatal mucosa supplied by the nerves from the sphenopalatine ganglion

The average total quantity of solution injected per patient and per area injected was 0 23 cc to one side of the septum, 0 08 cc to the middle turbinate of one side, and 1 87 cc to the inferior turbinate of one side One to two weeks were allowed to elapse between treatments, although not infrequently some patients received treatment to both sides of the nose, except the septum, at one sitting Patients considered unsuitable for treatment are those with severe asthma, and in these cases, if the nose was treated, it was necessary to explain that while the nasal treatment might result in some relief of asthma, this should not be expected as the treatment was directed to relieve only the nasal, sinus, ear and eye symptoms. Others considered unsuitable for treatment were patients with nasal allergy but with such unstable nervous systems and usually with such a multiplicity of other complaints that psychiatric rather than intranasal treatment seemed advisable

Following intranasal treatment with psylliate, some relief of symptoms could be expected in two or three weeks Within a few months after treatment, the mucosa, formerly pale greatly swollen and boggy, is found to be firm pink and of normal thickness, lying snugly against the bone of the underlying turbinate, and without ulceration, crusts, scabs, or atrophic areas The sense of smell is not impaired

The number of visits for psylliate treatments were one visit in 55 per cent cases two visits in 26 per cent cases three visits in 12 2 per cent four five or six visits in the remainder In children under a general anesthetic when both sides of the nose could be treated it was very rare (two or three cases) that more than one treatment was needed

Results of treatment were shown by the replies to follow up inquiries obtained in 568 cases treated Seventy-two patients (12 6 per cent) reported no benefit (average 4 33 cc. solution used per patient) while 496 (87 3 per cent) reported that the treatment helped them. Of the latter 50 (8 8 per cent) were better for from four to 12 months, 186 (32 7 per cent) were better for one to two years while 260 (45 7 per cent) stated they were relieved for from two to seven years In the latter group, an average of 5 09 cc. of solution was used per patient.

Of these 260, relief was as follows two years in 63 cases three years in 60 cases four years in 17 cases five years in 11 cases six years in 40 cases and seven years in nine cases

In 77 cases, patients returned for further treatments after intervals of from one to seven years, and of these five (6 4 per cent stated they were not helped, while the remaining 72 reported benefit, of which group, 54 (70 1 per cent) reported benefit lasting from two to six years The average quantity of psylliate solution per patient was 8 02 cc in this group

The average total quantity of procaine-sodium psylliate mixture used in all cases was 4 36 cc In 260 patients reporting most benefit, the total average quantity of solution used was 5 09 cc per patient In 35 more than usually severe cases of vasomotor rhinorrhea in adults, the total average quantity of solution used in several treatments was 11 9 cc Of these, 26, or 74 per cent, reported much help, four reported moderate (one to two years) relief, while five were helped little (four to 12 months)

In many adults relief of anosmia was a common result, while in children with conduction deafness improvement in hearing was the rule

Of 12 patients with asthma, eight volunteered that the intranasal treatment cured the asthma, while four stated their asthma was much better Of the 72 patients reporting no benefit from treatment, 16 (22 2 per cent) were asthmatic, as compared with 14 6 per cent asthmatics in the whole group treated

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OSTEOMYELITIS OF THE FRONTAL BONE*

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Newport News, Va

Osteomyelitis of the frontal bone complicating frontal sinusitis is today, fortunately, only occasionally encountered The widespread use of chemotherapy and the antibiotics in addition to a better understanding of nasal physiology and allergic manifestations and management have, for the most part, been the major factors in bringing this about.

The condition was, and continues to be, terrifying to both patient and physician As brought out by Brown,[1] it "presents difficulties in early diagnosis, taxes the surgeon's resourcefulness in making a decision to operate, frightens the patient with the possibilities of the resulting deformity and forms the basis for unlimited worry and anxiety on the part of the patient's family"

Since the appearance of Mosher's[2] comprehensive paper in 1940, the types of osteomyelitis, the anatomy and histology of the diploetic veins and bone marrow, and the complications have not changed, but, as he rightfully predicts in his concluding paragraph, the advent of modern drugs as we know them has altered in many ways the treatment and prognosis, and has masked the signs and symptoms formerly found in the natural course of the disease.

There are three distinct types of osteomyelitis fulminating, acute and chronic The fulminating type formerly the most dreaded of the three is rapidly diminishing under conservative present day management however, it should be remembered that the more localized types in some instances may suddenly progress rapidly and have a fulminating

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[*] Read at the meeting of the Cleveland Otolaryngological Club April 16, 195

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course We shall concern ourselves primarily with the acute — which may occur spontaneously, complicating sinus infections or following surgery, and the chronic — which may be a quiet continuation of acute, or cases of acute which have been improperly or inadequately treated

ETIOLOGY

Acute Pus under pressure in a sinus which is not draining is the main etiological factor Blockage may be due to allergies, post-traumatic deformities, nasal polypi or enlarged turbinates

Chronic Is primarily a quiet continuation of an acute process, or, becoming more into being today, cases of acute sinusitis which have been inadequately treated

BACTERIOLOGY

Acute In a series of cases seen by MacBeth,[3] in which bacterial records were available, the causative agents found were staphylococcus aureus, 39 per cent, anaerobic streptococcus, 35 per cent, streptococcus hemolyticus, 9 per cent, staphylococcus albus, 4 per cent, and sterile, 13 per cent

Chronic Usually caused by the same organisms Secondary invaders may at times cause a difference in cultures taken from the bone and the involved sinuses

PATHOLOGY

Acute A thrombophlebitis of the veins of the sinus mucosa extends by direct spread, causing an infection of the diploic spaces It is the tortuosity of these veins which makes removal of grossly healthy bone for a distance of 4 to 5 cm at the time of surgery imperative The diploic veins drain primarily towards the dura Regenerative capacity is slight, and the suture lines of the skull have little, if any, isolating function

Chronic The blood supply is gradually cut off by a process of thrombosis and endarteritis Osteogenesis and calcification ensue. In the less chronic, sequestra are more common, in the more chronic, a fibrosis of the marrow spaces occurs with relatively smooth healing

SYMPTOMATOLOGY

Acute Headache may be generalized or occipital and usually occurs at night Pyrexia may be present, but is variable Frontal swelling is common. This is at first doughy" and tender but may later become fluctuant. Proptosis is quite common

Chronic Frontal headache develops gradually and is not severe. Pyrexia is not usually seen There is a slow progressive osseous swelling over the frontal area There may be proptosis of one or both eyes.

RADIOLOGY

Acute There are no changes for the first seven to 10 days Later, mottling appears, but the diagnosis should be made before radiographic evidence is positive

Chronic Sequestra are present in the more acute forms Sclerosis and osteitic changes are present in the very chronic.

COMPLICATIONS

Acute Epidural abscess pachymeningitis, brain abscess acute meningitis and thrombosis of the venous sinuses should be watched for

Chronic The osteitic process may spread and involve the cranial nerves Septic thrombophlebitis may lead to meningitis or brain abscess

TREATMENT

Acute The patient should receive large doses of the drugs known to be effective against the particular organism present, and drainage should be established early An external trephine is advocated during the acute stage. Care should be taken to remove no more bone than is absolutely necessary and spongy bone should be avoided Therapy should be continued long after the clinical signs and symptoms have subsided The patient should be re-X-rayed at monthly intervals for nine to 12 months

[Treatment of the fulminating type is essentially the same, but should be more vigorous, and supplemented with oxygen, blood and other supportive measures as the need arises]

If the lesion continues to spread, or even if localized persists, operative removal should be undertaken The anticoagulants may have a place in preventing thrombosis[4]

Chronic Wide excision of the osteitic bone is the treatment of choice after the acute process, if present, has been controlled

As mentioned previously, a margin of bone beyond the obviously diseased process should be removed

Since the advent of chemotherapy, a primary surgical closure with adequate drainage and irrigation has been possible

Regeneration of bone in some instances, especially in the very young, has been complete with a good cosmetic result If not, suitable plates of tantalum have proved to be useful and completely satisfactory

Prognosis in all cases should still be carefully guarded, and the patient should be examined frequently, both clinically and radiographically

I should like to present two cases of osteomyelitis of the frontal bone

CASE REPORTS

Case 1 (Acute) H D R, 23 year-old white male, was admitted to the Veterans Administration Hospital on Jan 7, 1952 Five weeks prior to admission he first had onset of coryza, which developed into frontal pain with edema and tenderness over the anterior frontal region He was hospitalized elsewhere and was given penicillin, but this was shortly discontinued when patient proved to be sensitive to that drug He had four X ray treatments to the frontal area, after which the edema improved but did not completely subside Nasal discharge persisted, but was diminished, and he was discharged from that hospital after one week Two weeks prior to admission the symptoms recurred and the frontal swelling had become larger than at any time previously

On admission there was swelling over the frontal area measuring approximately 4 cm. in diameter in the midline just above the brow line. This was extremely tender to palpation but was not fluctuant. There was a considerable amount of mucopurulent discharge in both middle meatuses. Ewing's sign was positive bilaterally

Blood count, urinalysis and serology were normal X rays of the para nasal sinuses (see Fig 1) showed considerable clouding of the antra and frontal sinuses with some thickening of the frontal bone anterior to the frontal sinus. There was no definite evidence of osteomyelitis of the frontal bone

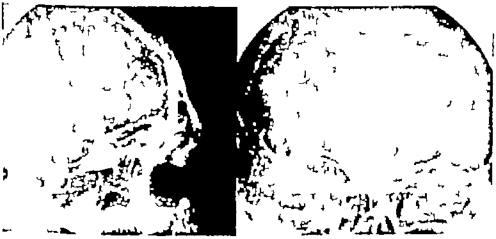

Fig. 1 Case 1. Admission Roentgenograms of frontal sinuses showing some thickening of the frontal bone anterior to the sinus and clouding of the frontal sinus

Temperature on admission was normal On Jan. 9 the antra were irrigated and a copious amount of thick purulent material was removed On Jan. 10 patient had bilateral trephination of the frontal sinuses and a large amount of pale yellow thick, creamy discharge was released under pressure. The mucosa grossly was normal. Drains were left in place for 72 hours at which time the discharge ceased spontaneously Cultures revealed a nonhemolytic streptococcus which was sensitive to terramycin, streptomycin aureomycin and chloromycetin but resistant to penicillin (see Fig. 2) He was therefore given terramycin 500 mgm. every six hours and chloromycetin 500 mgm. every six hours and treatment was continued for 21 days

His condition remained good following trephination, and although the frontal swelling disappeared the area for nasal drainage was not deemed adequate Allergic studies were negative On Jan. 22 he had bilateral antrotomies and in fracture of the middle turbinates.

At the time of discharge patient was symptom free. The frontal swelling had completely subsided and the areas for nasal drainage were considered adequate

Case 2 (Chronic) J E K 26 year-old white male was admitted to the hospital on Jan. 2 1952 complaining of intermittent frontal headache of five years duration. Onset followed coryza and he was treated with several injections of penicillin and symptoms subsided. Postnasal discharge persisted and headaches recurred several times yearly Three years previously he had had a bilateral nasal polypectomy but allergic studies were not carried out Over a period of two years the pains had become more frequent and more severe, especially for the past three months. Swelling of the forehead had been present for approximately one year There had been no nausea, vomiting, diplopia or vertigo He estimated that he had received 10 injections of penicillin during this period

On admission both middle meatuses contained a considerable quantity of thick mucopurulent discharge The nasal mucosa was edematous and pale A large solitary mucus polyp was present in the middle meatus posteriorly, on the right Ewing's sign was positive bilaterally There was grossly diffuse swelling of the frontal area, mainly on the right. This was only slightly tender to palpation and was not fluctuant

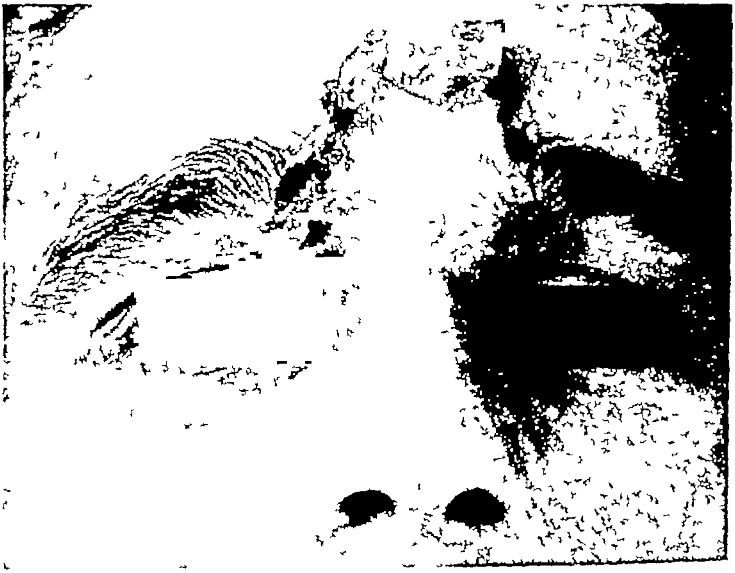

Fig 2 Case 1 Photograph taken on first postoperative day showing position of trephines with drains in place

Blood count, urinalysis and serology were normal X rays of the paranasal sinuses revealed clouding of all the sinuses with considerable bony sclerosis in the superior portion of the frontal bone (see Fig 3) Lateral projection revealed anterior thickening of the frontal bone overlying the frontal sinuses, and the junction of the mucoperiosteal borders was very indistinct Laminograms of the frontal sinuses revealed a chronic inflammation involving the frontal area consistent with an osteitis, but showing no evidence of osteomyelitis

Temperature on admission was normal and aside from frontal pain swelling and nasal discharge, patient was asymptomatic Antral washings revealed a copious amount of mucopurulent exudate which failed to reveal any growth In spite of this, treatment consisting of aqueous procaine penicillin 300 000 units twice daily and terramycin 500 mgm. every six hours, in addition to local nasal shrinkage was started On Jan 10, bilateral trephination of the frontal sinuses was performed releasing thick, creamy pulsating material from both sides Drains were left in place for 72 hours at which time the drainage ceased Cultures revealed anaerobic streptococci, which were greatly sensitive to terramycin, streptomycin, bacitracin aureomycin and chloromycetin but resistant to penicillin. Penicillin was therefore, discontinued and chloromycetin added as 500 mgm. every six hours.

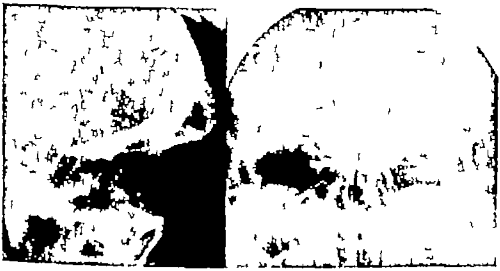

Fig 3 Case —. Admission Roentgenograms of frontal sinuses showing marked thickening of the frontal bone anterior to the sinus. The sinuses are cloudy and the mucoperiosteal borders are very indistinct. Sclerosis is marked.

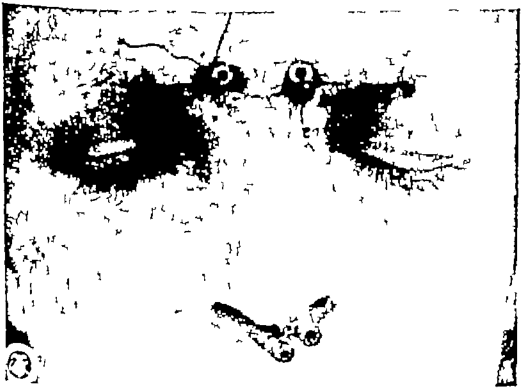

Fig 4. Case —. Photograph taken on third postoperative day following external radical frontal surgery showing the catheters in place. Openings were made in that part of the catheter resting in the frontal sinus and irrigations were used both from above and below

Allergic studies revealed marked sensitivity to dust, feathers silk and tobacco, and precautions were taken

On Jan 22, bilateral antrotomies, in fracture of the middle turbinates, nasal polypectomy and intranasal ethmoidectomy were carried out to facilitate drainage In spite of this, headaches and discharge persisted and the forehead swelling remained On Feb 5, bilateral radical frontal surgery was performed, revealing a large amount of creamy pus which cultured no growth The mucosa was edematous and grossly chronically infected This was completely and carefully removed The inner table was intact and grossly without defect or obvious involvement A large encapsulated ethmoid cell containing thick exudate under pressure was found just inferior to the frontal sinuses in the midline. This was completely removed, so that the frontal sinuses were united Bone overlying the right frontal sinus was pitted and friable, and a section was sent to the laboratory for microscopic diagnosis Drains were left in place for four days and the sinuses were irrigated daily (see Fig 4)

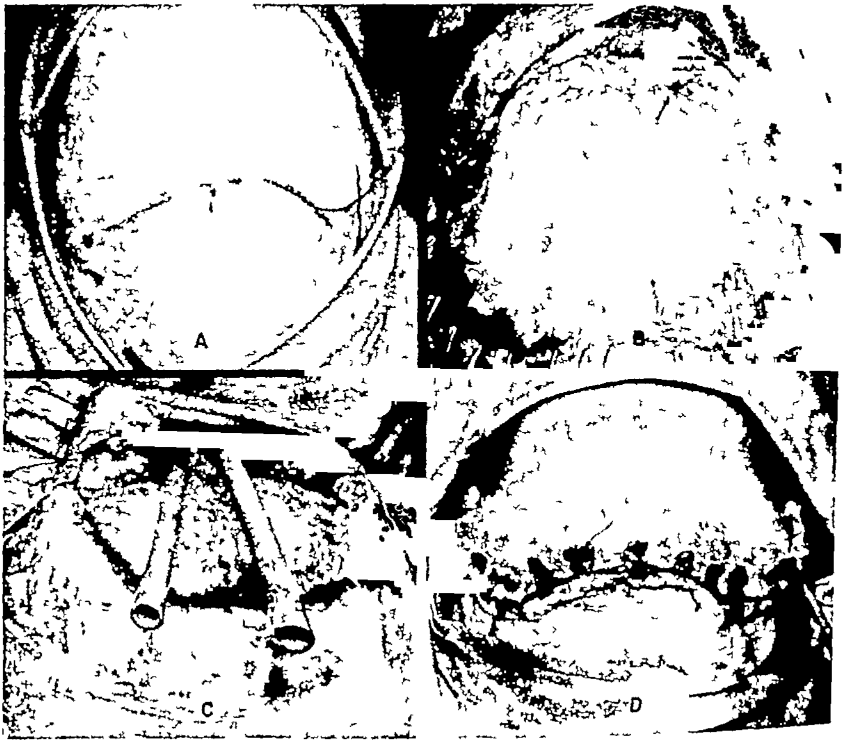

Fig 5 Case 2 Photographs taken at the time of the excision of the frontal bone (A) Modified coronal incision immediately posterior to the hair line (B) Flap drawn anteriorly revealing small fistula tract in bone on right (arrow) (C) Diseased bone with suitable margin has been removed and large rubber catheters left in place extending from epidural space downward through nasofrontal ducts (D) Incision closed. Transepidural catheter in place shown laterally

Following surgery the patient did very well for awhile but on the twelfth postoperative day his temperature began to spike daily to 100 Bone sections previously obtained revealed focal osteomyelitis and radical removal of the frontal bone was deemed advisable.

On March 6 a radical excision of the frontal bone with saucerization and curettage of the frontal sinuses was carried out. A modified coronal incision was used immediately posterior to the hairline and the flap was drawn anteriorly (see Fig 5) A small fistula in the frontal bone was present on the right. Sequestration was not present. The bone was eburnated, but the underlying dura was normal. All grossly involved bone was removed and a margin of approximately 4 cm. of apparently normal bone was similarly removed The frontal sinuses were found to be in surprisingly good condition but the inner plate was nevertheless removed. Most of the superciliary ridge was preserved Two No 20 perforated rubber catheters were left in place extending from the epidural space downward through the nasofrontal duct, and one No. 16 transepidural catheter for irrigation with bacitracin was left in place The incision was closed. Convalescence was uneventful The drains were removed on the seventh postoperative day and headaches, discharge and swelling have not recurred Antibiotics were continued for 28 days. X-rays on March 25 revealed normal bone surrounding the surgical defect (see Fig. 6) To date there have been no complications and impressions have been made for a tantalum plate which will be inserted later

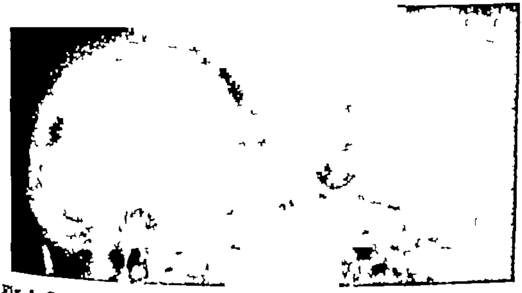

Fig. 6. Case 2. Roentgenograms showing normal bone surrounding surgical defect.

CONCLUSION

In conclusion, one fact of great importance should be emphasized It is becoming more and more evident that penicillin is becoming less and less effective in the treatment of infections formerly very susceptible to this drug Davison[8] reports that in 1946, 82 per cent of all gram positive cocci isolated from patients with infections of the paranasal sinuses were penicillin sensitive In 1949, this number had decreased to 12 per cent and is today probably even further diminished He postulates that perhaps the routine use of penicillin in infections of this type has set the stage for more virulent organisms proving to be penicillin-fast Local sprays, ineffective doses and disregard of physiological principles also may be possible reasons for this (Goodale[6]) The physician should not have a false sense of security and feel that drugs alone will eliminate paranasal sinus infections Cultures should be carried out, and these should include anaerobic studies Drug sensitivities also must be carried out if these diseases are to be properly treated and eliminated Anything short of this might well lead to a reappearance of all types of complications, not only of paranasal sinus infections but of all the infections peculiar to the ears, nose and throat

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Meeting Dec 12 13, 1952, San Salvador

INDEX

A

A Clinical and Research Version of the Bekesy Audiometer — Reger S N. 1333

Adenoma, Bronchial — Wolcott, C C. 1225

Adenoma, Lingual Thyroid Radioactive Iodine in the Diagnosis and Treatment of — Richardson, J R. and Lineback, M. 934

A Difference Limen Recruitment Test and Its Diagnostic Significance,—Jerger J F 1316

Adult Tonsillectomies Using Pentothal, Sodium Curare Pontocaine and Novocaine as the Anesthetic,—Johnson F 704

Air Embolism During Lavage of the Maxillary Sinus A Report of Two Cases —Pang L Q. 1205

An Afferent Representation of the Larynx in the Cerebellum — Lam, R. L., and Ogura, J H. 486

Anatomical Considerations of Deep Infections of the Neck,— Grant, J C. B. 787

Anesthetic Adult Tonsillectomies Using Pentothal Sodium Curare Pontocaine and Novocaine as the —Johnson, F. 704

An Evaluation of Postural Vertigo De Weese, D D. 262

A New Design for a Rongeur to Be Used in Lowering the Bony Septum —Seltzer A. P 1335

An Osler Item —Mosher H P. 577

Antrotomy Modified Radical — Shahinian L. 634

Antrum Maxillary Tumors of the —Weaver D F 139

A Self Retaining Dual Distal Lighted Laryngoscope with Screw Driven Fulcrum Lift, — Roberts S E. 215

Auditory Organ of Guinea Pigs Further Observations Concerning the Toxic Effects of Streptomycin and Quinine on the — Ruedi, L. Furrer W Luthy F Nager G and Tschirren B. 333

B

Bacteriologic Aid in Rhinologic Diagnosis and Treatment Improved Criteria,—Goldman, J L. 406

Bekesy Audiometer a Clinical and Research Version of the — Reger S. N. 1333

Bernoulli Action Nasal Sinus Drainage Factors Which Influence —Colson Z. W. 1023

Bilateral Midline Paralysis of the Larynx of Central Origin Its Occurrence as a Postoperative Complication — Judge A. F 1069

Bleeding Following Tonsillectomy —Fox, S L. 414

Bronchial Adenoma — Wolcott, C C. 1225

C

Carcinoma in Situ in Otolaryngology —Votaw R. 973

Carcinoma of Laryngopharynx,—Morrison, L F 53

Carcinoma of Larynx, Laryngectomy and Radical Neck Dissection for Carcinoma of Larynx,—Ogura, J H, and Bello, J A 1

Carcinoma of the Larynx, A Report of 194 Cases with 149 Laryngectomies, — McCall, J W, and Fisher, W R 475

Carcinoma, Squamous Cell, of the Tympanic Membrane,—Gisselsson, L 736

Causes and Mechanisms in Rhinitis—Wolf, S G Jr 601

Cephalgic Mechanisms with Special Reference to the Atypical Facial Neuralgias,—Kime, E N 284

Child the Problem of the Pre-school (Diagnostic Methods and the Otologist's Rôle in His Rehabilitation)—Bordley, J E 514

Clinical Observations on the Use of Autogenous Vaccine Made from Cultures of Coagulase Positive Hemolytic Staphylococcus Aureus,—Goodale, R L., and Mangiaracine A B 299

Clinical Results Following Differential Section of the VIIIth Nerve,—Barber, H O, and Ireland, P E 566

Correlation of the Predicted with the Actual Result of Fenestration in 164 Consecutive Cases,—Shambaugh, G E, Jr 461

D

Deafened Child, Rehabilitation of the,—Francis, G H 1089

Deafness Following Mumps, —Coombs, A J 204

Deafness, Perceptive, in Childhood—Scott Moncrieff, R 1081

Deafness, Pure Word,—Jones, J, and Dinolt, R 194

Destructive Carcinoma of the Nose Following a Stab Wound, —Seltzer, A P 528

Diseases, Virus, Recent Work in, —van Rooyen C E 805

E

Ear, Late Congenital Syphilis of the—Perlman, H B, and Leek, J H 1175

Electrocoagulation of the Vestibule in Guinea Pigs—Fernandez, C, Ludwig H., and McAuliffe D 1159

Encephalomeningocele, Intranasal Report of a Case,—Moore, P M 659

Eustachian Tube Closure, the Use of Cancellous Bone Grafting at Tympanomastoidectomy for Permanent a Preliminary Report,—Adin, L E 173

Extramedullary Plasma Cell Tumors of the Nose Pharynx and Larynx a Case Report,—Priest, R E 277

Extramedullary Plasmacytoma, —Clopton, J W 211

F

Fenestration Correlation of the Predicted with the Actual Result of in 164 Consecutive Cases—Shambaugh, G E, Jr 461

Fenestration in Animals, Functional Studies on Labyrinthine —Benedict, M R 1293

Fenestration Operation the Reaction of Tullio and the—Huizinga E. 741

Fenestration Surgery the Influence of on Bone Conduction Measurements,—McConnell F and Carhart, R 1267

Fibrous Dysplasia—McCart, H. 496

Frontal Bone Osteomyelitis of the—Mirmelstein A. B H. 1309

Functional Studies on Labyrinthine Fenestration in Animals—Benedict, M. R. 1293

Further Observations Concerning the Toxic Effects of Streptomycin and Quinine on the Auditory Organ of Guinea Pigs—Ruedi L. Furrer W Luthy F Nager G and Tschirren B 333

G

Globus Hystericus the Present Status of—Rigby R. G. 401

Glomus Jugulare Tumors—Mattick W L. and Burke E. M. 311

Glomus Jugularis Tumor of the Middle Ear (Carotid Body Tumor Nonchromaffin Paraganglioma)—Rosenwasser H 623

Grasses as Foreign Bodies in the Bronchus and Lung—Jackson Chevalier 897

Guinea Pigs, Electrocoagulation of the Vestibule in—Fernandez C Ludwig H. and McAuliffe D 1159

H

Hearing Testing a Critique of Present Day Methods of the Herbert Stanley Birkett Lecture—Wishart, D E S. 1045

Heart Resuscitation of the in the Practice of Otolaryngology—Lineback, M 352

Hormones and Otolaryngology—Mahoney J J 160

I

Influence of Fenestration Surgery on Bone Conduction Measurements,—McConnell F and Carhart R. 1267

Intranasal Encephalomeningocele Report of a Case—Moore P M. 659

L

Labyrinthitis Nonsuppurative the Differentiation Between Symptoms Referable to the Otolith Organs and Semicircular Canals in Patients with—Graybiel Capt. A. Niven J I and Walsh, T E. 924

Laryngectomy and Radical Neck Dissection for Carcinoma of the Larynx—Ogura J H. and Bello J A 1

Laryngectomy Tube for Oxygen Therapy—Andrews A H. 752

Laryngopharynx Carcinoma of the—Morrison L. F 53

Laryngoscope a Self Retaining Dual Distal Lighted with Screw Driven Fulcrum Lift,—Roberts S E. 215

Laryngoscope Modified for Oxygen Insufflation—Michels M. W 1121

Larynx, an Afferent Representation of the in the Cerebellum, Lam, R L, and Ogura, J H 486

Larynx, Bilateral Midline Paralysis of the of Central Origin, Its Occurrence as a Postoperative Complication,—Judge, A. F 1069

Larynx, Carcinoma of the, Laryngectomy and Radical Neck Dissection for—Ogura, J H, and Bello, J A. 1

Larynx, Carcinoma of the, a Report of 194 Cases with 149 Laryngectomies, — McCall J W, and Fisher, W R. 475

Late Congenital Syphilis of the Ear, — Perlman H B, and Leek, J H. 1175

Lecture, the Herbert Stanley Birkett A Critique of Present Day Methods of Hearing Testing,—Wishart, D E S 1045

M

Malignant Diseases of the Paranasal Sinuses with a Case Report of Primary Carcinoma of the Ethmoid Labyrinth Complicated by Nasal Polyposis, — Tolczynsky, B 722

Masking and Fatigue Effect of White Noise in Connection with Speech Tests,—Sambataro C, and Pestalozza, G 1197

Modified Radical Antrotomy, — Shahinian, L 634

Mumps Deafness Following — Coombs A J 204

N

Nasal and Paranasal Surgery, — Whelan, G L 846

Nasal Implants,—Pressman, J J 582

Nasal Polyps, the Treatment of by the Ruskin Method, — Cervantes, J J 535

Nasal Sinus Drainage, Factors Which Influence Bernoulli Action,—Colson, Z W 1028

Neck, Anatomical Considerations of Deep Infections of, — Grant, J C B 787

Nerves, Revised Anatomy of the Recurrent Laryngeal, Surgical Importance Based on the Dissection of 100 Cadavers A Preliminary Report, — Rustad, W H., and Morrison, L F 237

Neuralgias, Facial, Cephalgic Mechanisms with Special Reference to the Atypical, — Kime, E N 284

Neurofibroma, Otologic Evaluation of Unilateral Acoustic, Review of 150 Cases,—Brown, H. A Love, J G, and Adams, N D 250

Nose Carcinoma of the, Destructive Following a Stab Wound, —Seltzer, A. P 528

Nutrition and Related Problems —Jones, I H, Lewis, E. R, and Muckleston H S 1249

O

Odontogenic Tumors and Cysts — Heck, W E. 1097

Osler Item, an,—Mosher, H. P 577

Osteomyelitis of the Frontal Bone —Mirmelstein, A. B H 1359

Otitis Media, Secretory — Suehs O W 998

Otolaryngology Carcinoma in Situ in —Votaw R........ 973

Otolaryngology the Future of — Boies L R........ 709

Otologic Evaluation of Unilateral Acoustic Neurofibroma, Review of 150 Cases — Brown H. A. Love J G., and Adams N D.... 250

Otologic Symptoms in Multiple Sclerosis —Phillips J W 271

Otorhinolaryngologic Practice the Importance of Nutritional Surveys in —Rosenvold L. K........ 944

Oxygen Therapy Laryngectomy Tube for —Andrews A. H........ 753

P

Palsy Bell s and and Facial Paralysis Recent Advances in the Surgical Treatment of — Sullivan, J A........ 449

Paracusis Willisii, — Sullivan J A., and Hodges W E........ 678

Perceptive Deafness in Childhood —Scott Moncrieff R. 1081

Pharynx and Pharyngeal Surgery Review of the Available Literature on the —LeJeune F E. and Lewis M. 1137

Plasmacytoma Extramedullary — Clopton J W 211

Plastic and Reconstructive Surgery — Chamness J T., and Brown J B. 101

Poliomyelitis Bulbar Tracheotomy in —Friedman O and Gilbert J G 1112

Practical Considerations in the Relationship of Septal Procedures to Rhinoplasty —Anderson E. R. V........ 792

Pure Word Deafness —Jones J and Dinolt, R........ 194

R

Radioactive Iodine in the Diagnosis and Treatment of Lingual Thyroid Adenoma, — Richardson, J R. and Lineback, M.... 934

Recent Advances in the Surgical Treatment of Facial Paralysis and Bell s Palsy — Sullivan J A. 449

Recent Work in Virus Diseases — van Rooyen, C E........ 805

Recruitment and Speech Discrimination Loss — Huizing H. C. and Reyntjes J A........ 521

Rehabilitation of the Deafened Child —Francis G H........1089

Residual Hearing Following Partial Resection of the VIIIth Nerve —McKenzie K G 562

Resuscitation of the Heart in the Practice of Otolaryngology — Lineback M. 352

Review of the Available Literature on the Pharynx and Pharyngeal Surgery —LeJeune F E. and Lewis M........1137

Revised Anatomy of Recurrent Laryngeal Nerves Surgical Importance Based on the Dissection of 100 Cadavers A Preliminary Report —Rustad W H and Morrison, L E 237

Rhinitis, Causes and Mechanisms of,—Wolf, S G, Jr 601

Rhinologic Diagnosis and Treatment Bacterial Aid in Improved Criteria, — Goldman, J L 406

Rhinology in Children, Resume of and Comments on the Literature for 1951—Wishart, D E S Whaley, J B, and Wallace, W B 865

Rhinoplasty, Practical Considerations in the Relationship of Septal Procedures to, — Anderson E R V 792

S

Sclerosis Otologic Symptoms in Multiple,—Phillips, J W 271

Secretory Otitis Media, — Suehs, O W 998

Septum Bony, a New Design for a Rongeur to Be Used in Lowering the,—Seltzer, A P 1235

Sinus, Maxillary, Air Embolism During Lavage of the Report of Two Cases,—Pang, L Q 1205

Sinuses, Diseases of the Paranasal with a Case Report of Primary Carcinoma of the Ethmoid Labyrinth Complicated by Nasal Polyposis, — Tolczynsky, Borys 722

Sinusitis Hyperplasia, Treatment of—Silcox L E 426

Socialized Medicine in England,—Stevenson, R. S 813

Sodium Psylliate, Treatment of Hay Fever, Vasomotor Rhinitis and Vasomotor Sinusitis with 900 Cases,—Childrey, J H 1352

Squamous Cell Carcinoma of the Tympanic Membrane,—Gisselson, L 736

Surgery, Plastic and Reconstructive, — Chamness, J T, and Brown, J B 101

Surgical Destruction of the Labyrinth for Ménière's Disease, — Day K M 547

Surgical Treatment of Cervical Metastasis (Cancer of the Larynx),—Work W P 61

Symposium

Carcinoma of Larynx

- I—Carcinoma of the Laryngopharynx, Morrison, L F 53
- II—Cervical Metastasis Surgical Treatment,—Work, W P 61
- III—X ray Therapy, — Garland J H 75

Symposium

Surgical Treatment of Hydrops of the Labyrinth,—

- Day K M 547
- Flett, R. L. 556
- McKenzie, K G 562
- Barber, H O, and Ireland P E 566

Symposium

The Relationship of Bronchoscopy to Chest Surgery,—

- Kergin, F G. 765
- Jackson C L 772
- Broyles, E N 784

T

Test, a Difference Limen Recruitment, and Its Diagnostic Significance,—Jerger, J F 1316

Tests, Speech, Masking and Fatigue Effect of White Noise in Connection with, — Sambataro O and Pestalozza, G 1197

The Cardioesophageal Junction—A Histological Study —Strauss G D and Lubitz J M........ 359

The Diagnosis and Treatment of Acute Subdural Abscess Complicating Suppurative Frontal Sinusitis —Pitts W R........ 367

The Differentiation Between Symptoms Referable to the Otolith Organs and Semicircular Canals in Patients with Nonsuppurative Labyrinthitis, — Graybiel, Capt. A Niven, J I and Walsh, T E........ 924

The Future of Otolaryngology — Boies L. R........ 709

The Herbert Stanley Birkett Lecture A Critique of Present Day Methods of Hearing Testing — Wishart, D E. S........1045

The Importance of Nutritional Surveys in Otorhinolaryngologic Practice — Rosenvold L. K........ 944

The Portmann Operation —Flett R. L........ 556

The Present Status of Globus Hystericus —Rigby R. G........ 401

The Problem of the Preschool Child (Diagnostic Methods and the Otologist's Rôle in His Rehabilitation) —Bordley J E........ 514

The Reaction of Tullio and the Fenestration Operation — Huizinga E........ 741

The Relationship of Bronchoscopy to Chest Surgery Symposium,—
Kergin F G........ 765
Jackson C L........ 772
Broyles E. N........ 784

The Treatment of Nasal Polyps by the Ruskin Method — Cervantes J J........ 535

The Use of Cancellous Bone Grafting at Tympanomastoidectomy for Permanent Eustachian Tube Closure A Preliminary Report,—Adin L. E........ 173

Tonsillectomies Adult, Using Pentothal Sodium Curare Pontocaine and Novocaine as the Anesthetic —Johnson, F........ 704

Tonsillectomy Bleeding Following—Fox, S L........ 414

Tracheotomy in Bulbar Poliomyelitis — Friedman O and Gilbert J G........1112

Traumatic Rupture of the Tympanic Membrane — Jordan, L. W........ 615

Treatment of Hay Fever Vasomotor Rhinitis and Vasomotor Sinusitis with Sodium Psylliate—900 Cases,—Childrey J H........1352

Treatment of Hyperplastic Sinusitis —Silcox, L. E........ 426

Tumor Glomus Jugularis of the Middle Ear (Carotid Body Tumor Nonchromaffin Paraganglioma) —Rosenwasser H........ 633

Tumors and Cysts Odontogenic —Heck W E........1097

Tumors Extramedullary Plasma Cell of the Nose Pharynx and Larynx A Case Report — Priest, R. E........ 377

Tumors Glomus Jugulare —Mattick W L. and Burke E. M........ 311

Tumors of the Maxillary Antrum —Weaver D. F........ 139

V

Vertigo, Postural, an Evaluation of,—De Weese, D D 262

X

X ray Therapy (Cancer of the Larynx,—Garland, L. H 75

AUTHORS

A

Adams, N D , Love, J G , and Brown H A —Otologic Evaluation of Unilateral Acoustic Neurofibroma. Review of 150 Cases 250

Adin, L E —The Use of Cancellous Bone Grafting at Tympanomastoidectomy for Permanent Eustachian Tube Closure A Preliminary Report. 173

Anderson, E R. V — Practical Considerations in the Relationship of Septal Procedures to Rhinoplasty 792

Andrews, A. H — Laryngectomy Tube for Oxygen Therapy 752

B

Barber, H O , and Ireland, P E —Clinical Results Following Differential Section of the VIIIth Nerve 566

Bello, J A , and Ogura, J H — Laryngectomy and Radical Neck Dissection for Carcinoma of the Larynx 1

Benedict, M R —Functional Studies on Labyrinthine Fenestration in Animals 1293

Boies, L R —The Future of Otolaryngology 709

Bordley, J E —The Problem of the Preschool Child (Diagnostic Methods and the Otologist's Rôle in His Rehabilitation)..... 514

Brown, H A., Love, J G , and Adams, N D —Otologic Evaluation of Unilateral Acoustic Neurofibroma Review of 150 Cases 250

Brown, J B , and Chamness, J T — Plastic and Reconstructive Surgery 101

Broyles, E N —The Relationship of Bronchoscopy to Chest Surgery 784

Burke, E M , and Mattick, W L —Glomus Jugulare Tumors 311

C

Carhart, R , and McConnell, F —Influence of Fenestration Surgery on Bone Conduction Measurements 1267

Cervantes, J J —The Treatment of Nasal Polyps by the Ruskin Method 535

Chamness, J T , and Brown, J B — Plastic and Reconstructive Surgery 101

Childrey, J H — Treatment of Hay Fever Vasomotor Rhinitis and Vasomotor Sinusitis with Sodium Psylliate—900 Cases.. ..1352

Clopton, J W —Extramedullary Plasmacytoma 211

Colson, Z W — Nasal Sinus Drainage Factors Which Influence Bernoulli Action 1028

Coombs, A. J — Deafness Following Mumps 204

D

Day K. M.—Surgical Destruction of the Labyrinth for Ménière's Disease 547

De Weese, D D—An Evaluation of Postural Vertigo 262

Dinolt R., and Jones J—Pure Word Deafness 194

F

Fernandez, C Ludwig H. and McAuliffe, D—Electrocoagulation of the Vestibule in Guinea Pigs 1159

Fisher, W R and McCall, J W—Carcinoma of the Larynx. A Report of 194 Cases with 149 Laryngectomies 475

Flett R. L.—The Portmann Operation 556

Fox S L. — Bleeding Following Tonsillectomy 414

Francis, G H—Rehabilitation of the Deafened Child 1089

Friedman O., and Gilbert J G—Tracheotomy in Bulbar Poliomyelitis 1112

Furrer, W Ruedi L. Luthy F Nager, G., and Tschirren B—Further Observations Concerning the Toxic Effects of Streptomycin and Quinine on the Auditory Organ of Guinea Pigs 333

G

Garland L. H — X ray Therapy (Cancer of the Larynx) 75

Gilbert J G., and Friedman O—Tracheotomy in Bulbar Poliomyelitis 1112

Gisselsson L. — Squamous Cell Carcinoma of the Tympanic Membrane 736

Goldman J L.—Bacteriologic Aid in Rhinologic Diagnosis and Treatment Improved Criteria 406

Goodale, R. L., and Mangiaracine, A. B—Clinical Observations on the Use of Autogenous Vaccine Made from Cultures of Coagulase Positive Hemolytic Staphylococcus Aureus 299

Grant J C B—Anatomical Considerations of Deep Infections of the Neck 787

Graybiel, Capt A. Niven J L, and Walsh T E.—The Differentiation Between Symptoms Referable to the Otolith Organs and Semicircular Canals in Patients with Nonsuppurative Labyrinthitis 924

H

Heck, W E.—Odontogenic Tumors and Cysts 1097

Hodges W E and Sullivan J A.—Paracusis Willisii 678

Huizing H C., and Reyntjes J A. — Recruitment and Speech Discrimination 521

Huizinga E. — The Reaction of Tullio and the Fenestration Operation 741

INDEX

I

IRELAND, P E, and BARBER, H O —Clinical Results Following Differential Section of the VIIIth Nerve 566

J

JACKSON, C —Glasses as Foreign Bodies in the Bronchus and Lung 897

JACKSON, C L —The Relationship of Bronchoscopy to Chest Surgery 772

JERGER, J F —A Difference Limen Recruitment Test and Its Diagnostic Significance 1316

JOHNSON, F — Adult Tonsillectomies Using Pentothal Sodium Curare, Pontocaine and Novocaine as the Anesthetic 704

JONES, I H, LEWIS, E R, and MUCKLESTON, H S —Nutrition and Related Problems 1249

JONES J, and DINOLT, R —Pure Word Deafness 194

JORDAN, L W — Traumatic Rupture of the Tympanic Membrane 615

JUDGE, A F — Bilateral Midline Paralysis of the Larynx of Central Origin Its Occurrence as a Postoperative Complication 1069

K

KERGIN, F G—The Relationship of Bronchoscopy to Chest Surgery 765

KIME, E N —Cephalgic Mechanisms with Special Reference to the Atypical Facial Neuralgias 284

L

LAM, R L, and OGURA, J H—An Afferent Representation of the Larynx in the Cerebellum 486

LEEK, J H, and PERLMAN, H B— Late Congenital Syphilis of the Ear 1175

LEJEUNE, F E, and LEWIS, M — Review of Available Literature on the Pharynx and Pharyngeal Surgery 1137

LEWIS, E R, JONES, I H, and MUCKLESTON, H S —Nutrition and Related Problems 1249

LEWIS, M, and LEJEUNE, F E— Review of Available Literature on the Pharynx and Pharyngeal Surgery 1137

LINEBACK, M — Resuscitation of the Heart in the Practice of Otolaryngology 352

LINEBACK, M, and RICHARDSON, J R —Radioactive Iodine in the Diagnosis and Treatment of Lingual Thyroid Adenoma 934

LOVE, J G, BROWN, H A, and ADAMS, N D—Otologic Evaluation of Unilateral Acoustic Neurofibroma. Review of 150 Cases 250

LUBITZ, J M and STRAUSS, G D — The Cardioesophageal Junction—A Histological Study 359

LUDWIG, H, FERNANDEZ, C, and MCAULIFFE, D—Electrocoagulation of the Vestibule in Guinea Pigs 1159

LUTHY, F, RUEDI, L, FURRER, W, NAGER, G, and TSCHIRREN, B —Further Observations Concerning the Toxic Effects of Streptomycin and Quinine on the Auditory Organ of Guinea Pigs 333

Mc

McAuliffe, D Fernandez C and Ludwig H —Electrocoagulation of the Vestibule in Guinea Pigs 1159

McCall, J W and Fisher W R. —Carcinoma of the Larynx. A Report of 194 Cases with 149 Laryngectomies 475

McCart H —Fibrous Dysplasia 496

McConnell, F and Carhart R. —Influence of Fenestration Surgery on Bone Conduction Measurements 1267

McKenzie, K. G —Residual Hearing Following Partial Resection of the VIIIth Nerve 503

M

Mahoney J J — Hormones and Otolaryngology 160

Mangiaracine, A. B and Goodale, R L. — Clinical Observations on the Use of Autogenous Vaccine Made from Cultures of Coagulase Positive Hemolytic Staphylococcus Aureus 299

Mattick W L and Burke, E. M. —Glomus Jugulare Tumors 311

Michels, M W — Laryngoscope Modified for Oxygen Insufflation 1121

Mirmelstein A. B. H —Osteomyelitis of the Frontal Bone 1359

Moore, P M —Intranasal Encephalomeningocele Report of a Case 659

Morrison L F — Carcinoma of Laryngopharynx 53

Morrison L. F and Rustad W H.—Revised Anatomy of Recurrent Laryngeal Nerves. Surgical Importance Based on the Dissection of 100 Cadavers. A Preliminary Report 237

Mosher, H P —An Osler Item.... 577

Muckleston H. S Jones I H., and Lewis, E. R.—Nutrition and Related Problems 1249

N

Nager, G Luthy F Furrer, W Ruedi L. and Tschirren B —Further Observations Concerning the Toxic Effects of Streptomycin and Quinine on the Auditory Organ of Guinea Pigs 333

Niven J I Graybiel, Capt A. and Walsh T E.—The Differentiation Between Symptoms Referable to the Otolith Organs and Semicircular Canals in Patients with Nonsuppurative Labyrinthitis 924

O

Ogura J H and Bello J A. — Laryngectomy and Radical Neck Dissection for Carcinoma of the Larynx 1

Ogura J H and Lam R. L.—An Afferent Representation of the Larynx in the Cerebellum.... 486

P

Pang L. Q —Air Embolism During Lavage of the Maxillary Sinus. A Report of Two Cases..1203

Perlman, H B, and Leek, J H—Late Congenital Syphilis of the Ear 1175

Pestalozza, G, and Sambataro, C—Masking and Fatigue Effect of White Noise in Connection with Speech Tests 1197

Phillips, J W—Otologic Symptoms in Multiple Sclerosis 271

Pitts, W R—The Diagnosis and Treatment of Acute Subdural Abscess Complicating Suppurative Frontal Sinusitis 367

Pressman, J J—Nasal Implants 582

Priest, R E—Extramedullary Plasma Cell Tumors of the Nose, Pharynx and Larynx A Case Report 277

R

Reger, S N—A Clinical and Research Version of the Bekesy Audiometer 1333

Reyntjes, J A., and Huizing, H C—Recruitment and Speech Discrimination Loss 521

Richardson, J R, and Lineback, M—Radioactive Iodine in the Diagnosis and Treatment of Lingual Thyroid Adenoma 934

Rigby, R G—The Present Status of Globus Hystericus 401

Roberts, S E—A Self Retaining Dual Distal Lighted Laryngoscope with Screw Driven Fulcrum Lift 215

Rosenvold, L K—The Importance of Nutritional Surveys in Otorhinolaryngologic Practice 944

Rosenwasser, H—Glomus Jugularis Tumor of the Middle Ear (Carotid Body Tumor, Nonchromaffin Paraganglioma) 623

Ruedi, L, Furrer, W, Luthy, F, Nager, G, and Tschirren, B—Further Observations Concern the Toxic Effects of Streptomycin and Quinine on the Auditory Organ of Guinea Pigs 333

Rustad W H, and Morrison, L F—Revised Anatomy of Recurrent Laryngeal Nerves Surgical Importance Based on the Dissection of 100 Cadavers A Preliminary Report 237

S

Sambataro, C, and Pestalozza, G—Masking and Fatigue Effect of White Noise in Connection with Speech Tests 1197

Scott Moncrieff, R—Perceptive Deafness in Childhood 1081

Seltzer, A. P—A New Design for a Rongeur to Be used in Lowering the Bony Septum 1235

Seltzer, A. P—Destructive Carcinoma of the Nose Following a Stab Wound 528

Shahinian, L—Modified Radical Antrotomy 634

Shambaugh, G E, Jr.—Correlation of the Predicted with the Actual Result of Fenestration in 164 Consecutive Cases 461

Silcox, L E—Treatment of Hyperplastic Sinusitis 426

Stevenson, R S—Socialized Medicine in England 813

Strauss, G D., and Lubitz, J M — The Cardioesophageal Junction—A Histologic Study 359

Suehs, O W—Secretory Otitis Media 998

Sullivan J A.—Recent Advances in the Surgical Treatment of Facial Paralysis and Bells Palsy 449

Sullivan J A., and Hodges W E —Paracusis Willisii 678

T

Tolczynsky B —Malignant Diseases of the Paranasal Sinuses with a Case Report of Primary Carcinoma of the Ethmoid Labyrinth Complicated by Nasal Polyposis 722

Tschirren B Ruedi, L. Furrer, W Luthy F., and Nager, G — Further Observations Concerning the Toxic Effects of Streptomycin and Quinine on the Auditory Organ of Guinea Pigs 333

V

van Rooyen C E.—Recent Work in Virus Diseases 805

Voraw R.—Carcinoma in Situ in Otolaryngology 978

W

Wallace, W B Whaley J B., and Wishart D E. S—Rhinology in Children Resumé of and Comments on the Literature for 1951 865

Walsh T E. Graybiel, Capt A. and Niven J I—The Differentiation Between Symptoms Referable to the Otolith Organs and Semicircular Canals in Patients with Nonsuppurative Labyrinthitis 924

Weaver, D F — Tumors of the Maxillary Antrum 139

Whaley, J B. Wishart D E. S., and Wallace, W B—Rhinology in Children Resumé of and Comments on the Literature for 1951 865

Whelan, G L.—Nasal and Paranasal Surgery 846

Wishart D E. S—The Herbert Stanley Birkett Lecture A Critique of Present Day Methods of Hearing Testing 1045

Wishart D E S Whaley J B and Wallace, W B—Rhinology in Children Resumé of and Comments on the Literature for 1951 865

Wolcott C C. — Bronchial Adenoma 1225

Wolf S G Jr. — Causes and Mechanisms in Rhinitis 601

Work W P — Cervical Metastasis. Surgical Treatment (Cancer of the Larynx) 61

IN MEMORIAM

Guggenheim, L. K. 438

Lederman, M. D 1124

BOOK REVIEW

Brown V L.—The New Way to Better Hearing 90

Esser, C — Typographische Ausdeutung der Bronchien in Rontgenbild 90

Abstract of Vol. 40 of Acta Otolaryngologica 223

Honner, A. M.—Speech Training 854

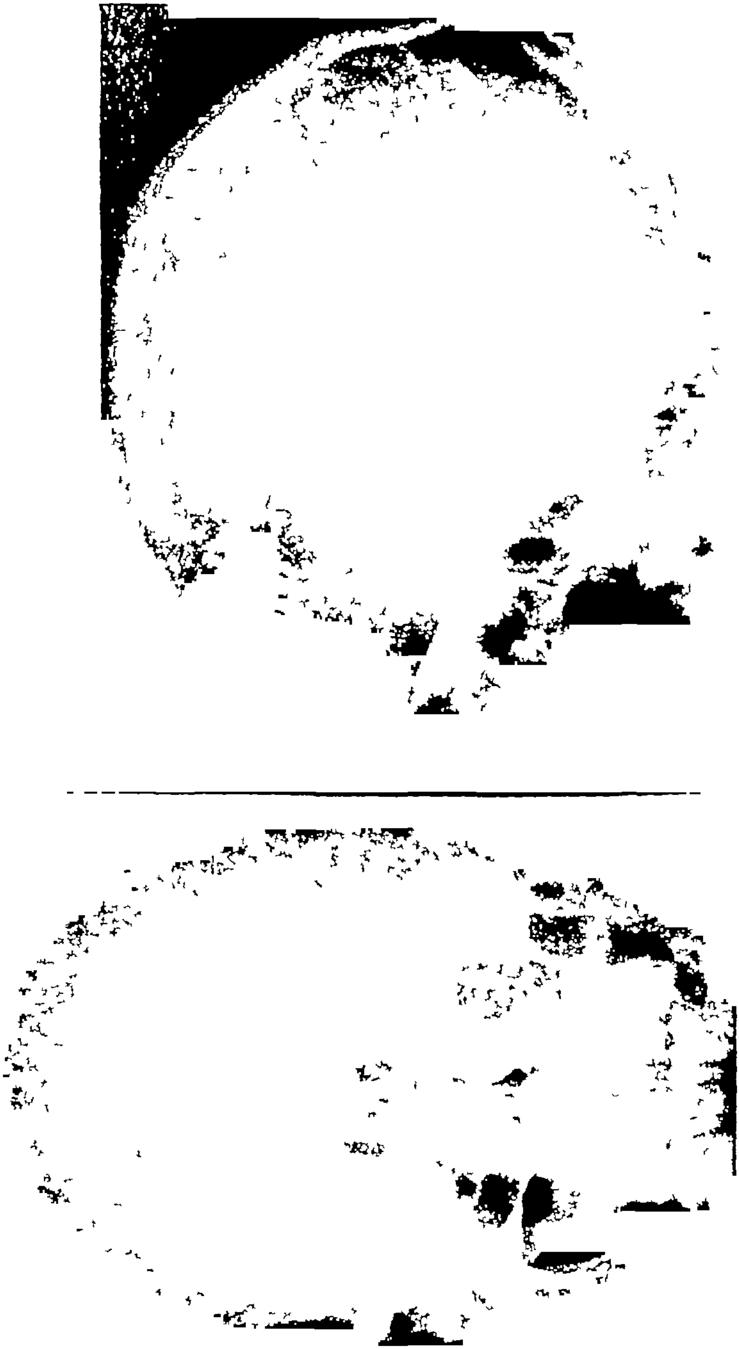

Fig 4B Case 3 Postoperative skull Roentgenograms depicting extent of bone removal in the frontal region and the site of burr openings for drainage of the subdural abscess

greenish yellow creamy odorless pus exuded. Immediate smear of the pus showed Gram positive cocci in clumps and chains Culture of the pus showed no growth. The burr hole was enlarged to the size of a 50-cent piece The arachnoid was found to be thickened and there were numerous fibrinous plaques over the exposed area. There was present a thin film of fibrinous tissue on the underneath surface of the dura. A considerable quantity of pus exuded however the brain was tight and tended to herniate obstructing the drainage of the pus. In order to lower the intracranial pressure and to facilitate the irrigation of the subdural space 30 cc of fluid were removed from the lumbar thecal sac through the inlying spinal puncture needle Following this maneuver the brain fell away from the dural edge and the subdural space was gently irrigated with warm saline solution through a soft rubber catheter *Irrigation was carried out until the returning fluid was completely clear* The subdural space was then irrigated with 90 cc. of a penicillin solution containing 90 000 units of penicillin. A second burr opening in the left temporal region, just anterior to the ear did not reveal any pus however the arachnoid appeared to be somewhat thicker than normal One *catheter was left in the subdural space near the left frontal pole and a* second catheter was placed in the left parietal region for drainage and future instillation of penicillin solution The wounds were closed and 5 000 units of penicillin in 5 cc of solution were instilled into each catheter

There was steady improvement after operation The stupor gradually lightened and after 24 hours the patient was able to take small amounts of liquids by mouth. The hemiparesis gradually improved. The fever subsided by lysis in seven days In 14 days the patient was sitting up eating well talking rationally there was only a slight dysphasia the motor power of the rightsided extremities was almost normal.

Postoperative therapy other than general care, included administration of penicillin and sulfonamides as indicated in Table VI On the fifth postoperative day the cerebrospinal fluid was grossly clear with a pressure of 160 mm. of fluid and a pleocytosis of only 30 cells there being only six polymorphonuclear leucocytes and 24 lymphocytes.

In the immediate postoperative period the control of convulsive seizures was somewhat of a problem. During the first five postoperative days the patient had Jacksonian seizures implicating the right face and upper extremity at irregular intervals and on several occasions these progressed to generalized convulsions necessitating the use of sodium pentothal intravenously Sodium luminal was used to control the Jacksonian seizures. From the eleventh postoperative day the patient was free of convulsive seizures.

There was only a slight amount of drainage from the left frontal wound One catheter was removed from the subdural space on the fourth postoperative day and the second one was removed on the seventh postoperative day Both cranial wounds healed by primary intention

On the sixteenth postoperative day (Feb 16 1951) the remaining portion of the anterior wall the posterior plate and the floor of the left frontal sinus were removed. The left frontal sinus was found to be filled with organizing granulation tissue and, on removing the posterior wall of the sinus granulation tissue was found to be very adherent to the dura just to the left of the midline Microscopic sections of the posterior plate of the left frontal sinus revealed chronic osteomyelitis with overlying ossifying periostitis.

On Feb 27, 1951 (11 days following eradication of the left frontal sinus), a secondary closure of the granulating wound in the center of the forehead was carried out. The patient's recovery was uneventful and he was discharged from the hospital on March 7, 1951, asymptomatic, without speech defect and with good motor power in his right sided extremities

The patient has remained well except for an occasional Jacksonian seizure implicating the right face and arm in a frequency of once every six or eight weeks, each seizure usually lasting a minute or two at a time The first Jacksonian seizure occurred two months after discharge from the hospital Since that time he has been controlled satisfactorily by the administration of anticonvulsant drugs The patient is now gainfully employed, and is to return in the near future for a tantalum cranioplasty

Comment This case illustrates the fallacy of too conservative surgery in the face of suppurative frontal sinusitis Antibiotics and sulfonamides cannot be expected to replace sound surgical principles, and should be used as an adjunct to surgery rather than a substitute for surgery Although the original signs of sinusitis pointed to most marked involvement of the right frontal sinus, eventually necrosis of the posterior plate on the left developed, giving rise to an epidural and subdural abscess on the left It is evident, from the pathology found at operation, that this patient had an osteomyelitis of the posterior plate of the left frontal sinus with direct extension of the infection through the plate and the dura, as evidenced by the granulations on the surface of the dura behind the posterior plate Recovery was satisfactory following drainage of the subdural abscess, although it was necessary to postpone eradication of the focus of infection until a later date after the patient had recovered from the acute intracranial infection This case illustrates the necessity of taking care of the acute subdural abscess primarily in those individuals where the condition of the patient is such that the eradication of the sinuses cannot be done at the same time and, therefore, must be postponed for a later date

Case 4 For five weeks intermittent suppurative frontal sinusitis was treated elsewhere with antibiotics and sulfonamides A sudden loss of consciousness and a generalized convulsion were followed by restlessness stupor, fever, right hemiparesis, dysphasia intracranial hypertension pleocytosis leucocytosis Immediate operation revealed extensive subdural abscess over the convexity of the left cerebral hemisphere bilateral suppurative frontal sinusitis necrosis of the posterior plate of the left frontal sinus with an epidural abscess The epidural and subdural abscesses were drained and bilateral frontal sinusectomy was car ried out in one sitting Therapy included systemic use of penicillin terramycin and sulfadiazine. Improvement was gradual for 16 days and almost complete when evidence of recurrence appeared. Mental confusion, fever intracranial hypertension, pleocytosis paralysis of the right foot led to drainage of pus from the longitudinal fissure on the left side. Death occurred 22 hours postoperatively Autopsy showed a small collection of pus on the orbital surface of the left frontal lobe a large right subdural abscess organizing leptomeningitis over the frontal lobe and focal hemorrhages in the pons

E. F C a 49 year-old male was admitted to the Charlotte Memorial *Hospital on May 31 1951, because of a recent* convulsion He had been troubled for a number of years with chronic sinusitis. Five weeks previous to admission the patient developed a sudden severe pain in the forehead which was worse over the left eye. For one week he had constant frontal pain and was treated for frontal sinusitis elsewhere Four weeks prior to admission the frontal sinusitis having apparently subsided a polyp was removed from the patient's nose and he returned to his work for one week even though there was some persistent tenderness over the frontal area Three weeks prior to admission the patient had a flareup of his sinusitis which was characterized by pain over the frontal region and particularly over the left eye. He was again put on chemotherapy and remained in bed at home for two weeks with head ache and low grade fever During this interval there was considerable swelling about the left eye and at one time the left eye was almost completely closed. Nine days previous to admission the symptoms had subsided and the patient returned to work for one week. Thirty six *hours* prior to entry the patient noted a *feeling of tightness across his* forehead, and 12 hours later the patient had to give up his work because of general malaise fever (102°) Shortly thereafter 20 hours previous to admission, he had a chill. An internist prescribed terramycin over the telephone Two and one-half hours previous to admission the patient's wife noted that he was somewhat confused and was reluctant to talk. One hour previous to admission to the hospital the patient had a generalized convulsive seizure Following the cessation of this convulsion the patient was in a wild maniacal restless confused condition. A medical consultant administered 2 gr of sodium luminal intramuscularly at home and transferred the patient immediately to the hospital.

On admission to the Charlotte Memorial Hospital the temperature was 103° F (P R) pulse rate 100 respirations 32 Mild nuchal rigidity was present, and other than the wild maniacal restless confused state the neurologic examination was reported to have been negative. Patient was suspected of having meningitis. Immediate lumbar puncture revealed a slightly turbid cerebrospinal fluid under a pressure of 250 mm. of fluid the cell count was 1,956 cells per cm. (95 per cent polymorphonuclear leucocytes and 5 per cent lymphocytes) the total protein content was 217 mg. per hundred cc., globulin 2 plus sugar 95 mg per hundred cc and *chlorides* 682 mg. per hundred cc. Cultures of the fluid reported later *showed* microaerophilic beta streptococcus. Immediate therapy was initiated consisting of penicillin, dihydrostreptomycin, and sodium sulfadiazine

Neurosurgical consultation six hours following admission to the hospital, *revealed* an acutely ill male The patient was in a rather wild, restless semistuporous state thrashing about the bed He was speechless and was unable to follow simple commands. There was present a weakness of the rightsided extremities and the right side of the face the most marked involvement being in the right upper extremity The patient's hyperactivity made reflex examination unsatisfactory Massive sedation in the form of 4 gr of sodium luminal intramuscularly, 7 5 gr of sodium amytal intravenously, and sodium pentothal gm 0 5 intravenously were necessary to quiet the patient. Roentgenograms of the sinuses revealed small frontal sinuses which were cloudy bilaterally Both antra showed the presence of discrete polyps The left ethmoid appeared clear but the right was somewhat hazy Emergency operation was performed for a suspected acute subdural abscess secondary to bilateral recurrent, acute suppurative frontal sinuisitis

At operation, May 31, 1951, through a burr hole placed in the mid parietal region on the left side the dura appeared to be whiter than normal and under tension The burr hole was then enlarged to the size of a 50 cent piece, and upon incising the dura there was an escape of odorless grayish yellow thick pus Immediate smear of the pus revealed numerous pus cells with Gram positive cocci in chains Culture, reported later, revealed microaerophilic beta streptococcus An estimated 100 to 125 cc of pus was aspirated from the left subdural space and it seemed to cover the convexity of the entire left hemisphere The subdural space was washed out with normal saline until the fluid returned clear Following the cleansing of the subdural space, patient s general condition, which had been extremely precarious previous to the operation, improved It was, therefore, decided that the focus of infection in the frontal sinuses could be eradicated at this time The entire frontal bone was visualized by reflecting the scalp to the supraorbital ridge bilaterally by means of a coronal incision. The frontal bone showed evidence of osteomyelitis just above the supraorbital ridge, there being softening and discoloration of the bone A burr hole was made on the left side just above the left frontal sinus At the tip of the frontal pole, behind the posterior wall of the left frontal sinus, a collection of 15 cc of pus was found in the epidural space Granulation tissue was present on the dura in this area and droplets of pus exuded from a small opening in the middle of the area of granulation An opening, 7 mm. in diameter, was found in the posterior plate of the left frontal sinus Both frontal sinuses were found to be filled with thick creamy pus The anterior wall of the left frontal sinus was soft and showed a honeycomb effect with pus Pathological studies of the bone removed from the anterior and posterior wall of the left frontal sinus revealed chronic osteomyelitis The anterior and posterior walls of the left and right frontal sinuses were completely removed and the lining membrane stripped out Drainage of the epidural space was had by bringing a soft rubber catheter from the frontal pole out through the temporal margin of the coronal incision The subdural space was drained by two soft rubber catheters, one extending to the frontal pole, and the other into the left temporal region At the end of the procedure the patient's general condition was much improved

The postoperative course was rather stormy for four days and was marked by extreme restlessness however, patient did not have any convulsive seizures The schedule of the systemic administration of antibiotics and sulfonamides is shown in Table VI No penicillin was injected into the subdural space, and there was very little drainage from the subdural catheters, which were removed on the fifth postoperative day One hundred thousand units of penicillin in 10 cc of solution were injected into the epidural space through the inlying catheter once daily for seven days The stupor gradually lightened and the restlessness improved over a period of four days, at which time the patient was able to take fluids in quantity by mouth On the fifth postoperative day the patient talked for the first time but a marked dysphasia was evident, as well as a moderate right hemiparesis The fever cleared up by lysis over a period of seven days. On the fifth postoperative day the cerebrospinal pressure was 80 mm of fluid the cell count was 110 with 80 per cent polymorphonuclear leucocytes and 20 per cent lymphocytes

The wounds healed by primary intention and the dysphasia and right hemiparesis gradually improved over a span of 18 days. The patient was ready for discharge from the hospital and had been allowed on the campus of the hospital for two days when signs of recurrence appeared On the sixteenth postoperative day six days after the penicillin had been discontinued and three days after discontinuance of the sulfadiazine there was noted some slowing of the mental processes of the patient and while eating lunch he suddenly developed a marked temporary paresis of the rightsided extremities for a period of two hours On the following day the patient was more lethargic was restless, and his temperature was 100° F (P O) Examination at this time revealed that the patient alternated between lethargy and restlessness but was oriented for time and place. He was able to name objects satisfactorily There was present a mild right hemiparesis the lower extremity being involved more than the upper and the right foot was completely paralyzed The fundi did not show any papilledema. Babinski sign was not present. The scalp over the bony defect in the frontal region was full and did not pulsate. The blood leucocyte count was 24 600 there being 83 per cent polymorphonuclear leucocytes 8 per cent stab forms 8 per cent lymphocytes 2 per cent eosinophiles Lumbar puncture revealed a faintly turbid cerebrospinal fluid under a pressure of 370 mm. of fluid with pleocytosis of 1,957 95 per cent polymorphonucleor leucocytes 5 per cent lymphocytes. In view of the presence of intracranial hypertension signs of infection and the progressive hemiparesis implicating primarily the right foot and lower extremity we were led to believe that the patient had a collection of pus in the longitudinal fissure on the left side therefore penicillin and sulfadiazine therapy was resumed and immediate operation was carried out. Burr holes were made in the posterior frontal anterior parietal and posterior parietal regions about 2 cm. to the left of the midline The dura in the frontal region was found to be white and somewhat thickened and upon incising the dura a small collection of pus was found along the longitudinal fissure When the left hemisphere was retracted laterally pus welled up from between the hemispheres. The subdural space along the longitudinal fissure was irrigated with warm saline. Pus was also obtained in small quantities through the anterior parietal burr hole In this area there was thickening of the dura and there was considerable fibrinous exudate on the cortex of the brain The posterior parietal burr hole which was 5 cm. anterior to the occipitoparietal suture line revealed no evidence of pus or exudate on the surfaces of the brain. In order to afford more adequate drainage of the longitudinal fissure the burr hole incisions were joined together and a block resection of bone 11 cm. long and 3 cm. wide was carried out, extending from the posterior parietal region to the midfrontal region The dura was opened through the extent of this incision except for the point of entrance of the rolandic veins to the longitudinal sinus To facilitate the irrigation of the subdural space 15 cc. of cerebrospinal fluid were removed from an inlying lumbar puncture needle which collapsed the hemisphere thereby making the irrigation much more effective. A small No 8 soft rubber catheter was left in the interhemispheral space for drainage and for immediate instillation of penicillin The amount of pus found between the hemispheres was small and the pockets were definitely less extensive than what had been anticipated preopera tively At the end of the procedure the brain was still tight which led us to suspect that the patient still had an undisclosed pocket of pus intracranially, however, his general condition was so poor at this time that it was felt that further exploration was unjustifiable

The patient did not improve postoperatively He remained comatose Fever arose to 103 6° F (P R) pulse 130, respirations 36 and labored The scalp in the region of the bony defect in the left frontal area was bulging In view of the persistent intracranial hypertension the right hemiplegia the possibility of a left frontal lobe abscess was entertained and the left frontal lobe was tapped, but no pus was found Lumbar puncture revealed a cloudy field, under 320 mm of pressure, with a cell count of 1 600, 98 per cent polymorphonuclear leucocytes Patient died a respiratory death 22 hours following second operation

At autopsy no evidence of infection was found in the region of the previously ablated frontal sinuses or the epidural space The sphenoid and ethmoid sinuses were found to be normal On the anteroinferior medial aspect of the left frontal pole a collection of approximately 12 cc of greenish yellow pus was found, and approximately 60 cc of similar purulent material was found over the convexity of the right frontal parietal and temporal lobes There was thickening and slight hyperemia of the leptomeninges of the convexity of the right hemisphere from the frontal pole to the parietal area, including the right temporal lobe A similar situation was found over the medial portion of the left frontal lobe for an area of about 3 cm There was little or no thickening of the meninges elsewhere over the anterior portion of the left frontal lobe The cerebral gyri were slightly flattened and the intervening sulci slightly narrowed most conspicuously over the right hemisphere anteriorly There was no gross evidence of temporal lobe or cerebellar herniation There was no evidence of thrombosis of the cortical veins or the longitudinal sinus Microscopic studies taken from the frontal lobes revealed an organizing leptomeningitis There was no evidence of areas of cerebral softening Punctate and focal hemorrhages were found in the pons The lungs showed a bilateral bronchial pneumonia, lower lobes

Comment This is an example of acute suppurative frontal sinusitis superimposed upon a chronic frontal sinusitis which was improved with chemotherapy, however, there was recurrence of the infection on two occasions upon cessation of the chemotherapy Osteomyelitis of the frontal bone finally developed, with erosion of the posterior wall of the left frontal sinus and the formation of an epidural abscess with extension of the infection directly through the dura to form a left subdural abscess The prompt drainage of the left subdural abscess gave temporary relief of signs and symptoms, however, a persistent small collection of pus on the inferior medial aspect of the left frontal pole led to the extension of the infection up through the longitudinal fissure beneath the falx cerebri and over the right cerebral hemisphere Although the intrahemispheral collection was recognized and drained, failure to recognize the presence of the collection over the right hemisphere led to persistent intracranial hypertension, giving rise to petechial hemorrhages in the pons resulting in death This case serves to emphasize the fact that certainly bilateral frontal burr holes should be done in all patients suspected of harboring a subdural abscess, if the suspected side does not yield sufficient pathology to explain the syndrome and possibly in all cases of subdural abscess even though sufficient pathology is found on one side to explain the syndrome.

The cranial subdural space is a potential space, just as the pleural and pericardial cavities are potential spaces It is bound on one side by the dura mater and on the other by the arachnoid Subdural abscess consists of a collection of purulent material in the subdural space overlying one or both cerebral hemispheres Large collections of exudate are most likely to occur over the dorsolateral surfaces of the cerebral hemispheres because of the absence of any anatomic structures traversing the subdural space in that area Pus that collects in the subdural space over one cerebral hemisphere tends to remain limited to one side, however, under pressure the fluid may cross to the opposite side via the subdural space in the longitudinal fissure, *i e*, under the falx cerebri, as in Case 4 of this series. Schiller, Cairns and Russell,[6] Keith and McKenzie[7] and more recently List,[8] have shown that interhemispheral suppuration is far more common than previously realized

PATHOGENESIS

Acute pyogenic infection of the subdural space may develop either by direct or indirect route In the first instance a neighboring suppurative process extends directly through the dura. Suppurative frontal sinusitis, therefore may lead to osteomyelitis of the posterior wall of the frontal sinus with necrosis of bone formation of an extradural abscess and, finally to subdural abscess, with or without actual perforation of the dura. An example of this mode of spread is seen in Case 1 of our series. The indirect vascular route of infection is probably more common. In severe suppurative frontal sinusitis, thrombophlebitis of mucosal or orbital veins may develop and continue into the diploe of the skull, dural veins and sinuses, and finally into cerebral veins Due to the exposed course of some of the dural and cerebral veins in the subdural space the formation of the subdural abscess is not unlikely Once the infection has reached the subdural space it usually spreads rapidly over the convexity of the cerebral hemisphere without meeting obstacles and may extend from the frontal to the occipital pole Under pressure, over a period of time, it is apt to invade the longitudinal fissure and extend beneath the falx to the other side List[8] called attention to the fact that this was especially apt to occur when the purulent process originates at the orbital surface of the frontal pole Case 4 in our series demonstrates the spread to the longitudinal fissure and the opposite hemisphere from a residual pocket on the orbital surface of the frontal pole Thus, acute subdural abscess, secondary to suppurative frontal sinusitis, develops progressively in an anteroposterior direction, affecting either the dorsolateral surface of the hemisphere or the longitudinal fissure, or both regions

The common infecting organisms in acute subdural abscess are usually the ones found in other intracranial infections arising from sinusitis, namely, pneumococcus, streptococcus, staphylococcus and influenzae bacillus The causative organisms in our four cases were streptococcus and hemolytic staphylococcus aureus (see Table I)

CLINICAL SYMPTOMS, SIGNS AND DIAGNOSIS

The diagnosis of acute subdural abscess should not be unduly difficult if one is familiar with the usual course followed by this condition and realizes the possibility of its existence in the case at hand Failure to make this diagnosis is most frequently due to failure to consider the possibility of this serious complication In acute suppurative frontal sinusitis, with or without antecedent sinus disease, followed by orbital swelling, persistent headache, malaise, fever, at times with chills, meningeal signs and lethargy, one should be very suspicious of subdural abscess Under such circumstances, should evidences of profound intracranial disease suddenly appear, the diagnosis is almost certain Courville[1] stated as a "clinicopathologic aphorism that 'in the presence of acute frontal sinusitis (empyema) the sudden onset of Jacksonian convulsions, hemiplegia and (if the major side of the brain is affected) aphasia, usually indicate the development of a subdural abscess" Jacksonian attacks occurred in three of our cases, and the intracranial complication was heralded by a generalized seizure in Case 4 It is important not only to diagnose the presence of subdural abscess but also to determine its location this is frequently possible by clinical evidence alone Collections of exudate over the frontoparietal convexity and Sylvian fissure cause focal convulsive attacks involving the eyes, face and upper extremity Usually this is soon followed by a weakness of the face and upper extremity, and dysphagia (in leftsided lesions) As the hemiparesis increases, there is usually paralysis of conjugate gaze to the paretic side however in stuporous individuals this sign may not be elicited On the other hand, collections of pus in the longitudinal fissure are apt to produce Jacksonian attacks affecting the leg, followed by a paresis and sensory loss in the lower extremities with progressive weakness of the entire side, usually sparing the facial muscles

Although the abscess will usually be found on the side of the known frontal sinusitis, it should be appreciated that the circumstances may lead to the development of an abscess on the opposite side This is readily understandable when one realizes that *a frontal sinus* may extend across the midline thus having its posterior wall in apposition to the dura on both sides of the sagittal sinus, moreover closure of the septum between the frontal sinuses is frequently incomplete, and both frontal sinuses are diseased, though the symptoms may point largely to one Bilateral suppurative frontal sinusitis was present *in all four of our cases. It must be* remembered that if the subdural abscess develops by an extension of thrombophlebitis through the sagittal sinus, it is a matter of chance on which side the space becomes infected and in fact, bilateral disease may develop Occasionally the paralysis may develop on the same side as the lesion and when this does occur, it is thought to be due to marked displacement of the brain, causing pressure of the edge of the tentorium against the peduncle of the opposite cerebral hemisphere Dilatation of the pupil, when present, is a good lateralizing sign, but even this sign is not infallible Pupillary inequality was not noted in any of our patients

The optic fundi do not usually show papilledema, however, engorgement of the veins is usually present, and in neglected cases, early low-grade papilledema may be found One of our cases showed beginning papilledema

The temperature is usually moderately elevated and the pulse somewhat slower than one might expect for the degree of fever The white blood cell counts ranged from 19 to 31,000 in our cases, and there was a predominance of polymorphonuclear cells (see Table II)

The cerebrospinal fluid pressure is elevated, ranging between 190 to 460 mm of fluid in the late stages of the disease The fluid is usually slightly turbid due to a pleocytosis of from a hundred to several thousand, with a predominance of polymorphonuclear leucocytes Only in one instance were we able to grow organisms on culture from the spinal fluid (see Case 4) This indicated a concomitant septic leptomeningitis Roentgenograms of the skull and sinuses usually depict nothing more than clouding of the sinuses It is common knowledge that Roentgenographic changes in bones do not appear for about a week after infection has set in, and, therefore, Roentgenograms cannot be depended upon in the diagnosis of subdural abscess Should sufficient calcium be present in the pineal body for Roentgenographic visualization, a lateral shift of the pineal would become a significant lateralizing sign

Differential diagnosis of acute subdural abscess lies between intracerebral abscess, epidural abscess, purulent meningitis and longitudinal sinus thrombosis Extradural abscess gives rise to a much milder illness than does subdural abscess Usually there are only mild signs of meningeal irritation, no focal signs of cerebral damage, and the patient does not appear critically ill and does not run a drastic fulminating course. In the patient with increasing intracranial pressure meningeal signs, stupor, focal neurologic signs or symptoms the discovery of extradural pus should not lead one to believe this to be the only complication, subdural abscess may very likely be present in addition to the extradural abscess, such were the findings in Case 4 of our series

Purulent meningitis, when accompanied by thrombosis of cortical veins, may often confuse the diagnosis, although this condition is rarely a sequela of frontal sinusitis The course of meningitis as a rule, is not as drastic as subdural abscess progressive focal neurologic signs are not usually present, and the cerebrospinal fluid pleocytosis is usually much higher than that in subdural abscess The presence of meningitis in a patient with focal neurologic signs does not detract from the diagnosis of subdural abscess. In fact the two may coexist (see Case 4)

The invasive stage of intracerebral abscess formation is milder less dramatic and more protracted than subdural abscess. The headache is less severe and varies considerably in intensity The temperature does not reach excessive heights and subsides after a short time Meningeal signs are usually absent and pleocytosis is much less marked. Intracerebral abscess may form rapidly at times, simulating a true cerebritis, and create a clinical picture indistinguishable from subdural abscess. In such instances, an immediate trephination in the frontal region under local anesthesia will settle the issue without jeopardizing the patient.

Thrombosis of the longitudinal sinus may simulate a syndrome of subdural abscess and in fact, the two may be coexistent In thrombosis the course is variable and the temperature curve septic in type Alternating convulsions right and left are often present beginning in the foot, and bilateral neurologic signs are usually found in both lower extremities. Meningeal signs are mild or absent in longitudinal sinus thrombosis and the cerebrospinal fluid shows little or no pleocytosis.

PREVENTION

Subdural abscess is prevented from developing in most cases of frontal sinusitis by active treatment of the sinus, including drainage, when indicated, and the administration of sulfonamides and antibiotics It is the responsibility of the rhinologist to determine when operative intervention for frontal sinusitis is indicated Such decisions should be made with full knowledge of the fact that chemotherapy and antibiotics are not a substitute for sound surgical principles but are adjuncts which may even extend the field of surgery If this dreadful complication of suppurative frontal sinusitis is to be prevented, we must be on the alert for signs of failure of conservative measures and antibiotics The appearance of the posterior bony plate at the time of sinusotomy cannot be relied upon in determining whether or not the infection has spread intracranially In our cases necrosis of the posterior plate was found in only one instance (see Case 4) , therefore, if the surgeon does not feel that the posterior bony plate should be opened at the time of providing open drainage of the sinus, he should be on the alert for warning signs which are usually present for days before the development of a subdural abscess The dura in the region behind the frontal sinus is pain sensitive, and the reference of the pain is in the local frontal region Inflammation of the dura or pressure of a local extradural abscess is sufficient to incite pain The persistence or the development of frontal headache after simple frontal sinusotomy is very suggestive of the presence of extradural infection There may be accompanying low-grade fever, leucocytosis, and, in the later stages, lethargy and signs of meningeal irritation An extradural abscess can be relieved only by drainage, and if allowed to persist will certainly lead to a subdural abscess or other serious intracranial infection This is clearly demonstrated in Case 4, therefore, the persistence or the recurrence of frontal pain with or without other signs should be an indication for opening the posterior wall of the frontal sinus

The rhinologist should not be deterred from removing the posterior wall of the frontal sinus, when indicated, by the fear of leaving the patient with a marked deformity of the forehead These bony defects may be repaired at a later date when the infection has subsided, by appropriate cranioplasty without any difficulty We have carried out cranioplasty on Cases 1 and 2 and repaired the bony defect with a tantalum plate. By use of a coronal incision, cranioplasty has been carried out without a visible scar outside of the hair line (see Figs 1 and 3) Case 3 is to report for tantalum plate cranioplasty in the near future

TREATMENT

Acute subdural abscess must be regarded as an emergency, and immediate operative intervention is mandatory Simple trephination of the skull in the frontal region will immediately establish the diagnosis. Both sides should be explored so that bilateral involvement may not be overlooked Failure to explore both sides at the time of recurrence of difficulty in our Case 4 resulted in a fatality because of an overlooked collection over the convexity of the unexposed right hemisphere which did not produce localizing signs Measures to control the infection should be taken promptly, and before surgery is attempted antibiotics and sulfonamides should be given in massive doses Time should not be wasted in awaiting the outcome of the bacteriological studies to identify the responsible organisms whereby the appropriate drug can more accurately be selected One to two hundred thousand units of penicillin should be administered intramuscularly every three hours Sodium sulfadiazine in a dosage of 4 gm should be given intramuscularly immediately and should be administered in appropriate divided doses in the amount of 6 gm per 24 hours. Once these measures have been instituted in an effort to inhibit the spread of infection, immediate drainage of the pus from the subdural space of these extremely ill patients is mandatory In the early stage of this disease the pus is liquid and easily drained however, in the chronic state the pus is transformed into a thick plastic exudate Moreover the early drainage of the exudate from the subdural space, while it is confined to the frontal pole and before it has extended posteriorly over the sensorimotor cortex of the brain, may lessen the incidence of the dreaded sequela, convulsive disorders

The primary incision for the identification and drainage of an acute subdural abscess should be made over the suspected site of the lesion, in a clean field, in the midfrontal region If pus is found, the burr hole is enlarged slightly and additional openings are made in the parietal, temporal and even the occipital area until the full extent of the collection has been defined Once the extent of the exudate has been established, the pus is aspirated from the subdural space, and the space is carefully and gently washed out with warm saline In extensive collections, multiple burr holes are necessary Through these openings through-and-through irrigation may be facilitated In the face of intracranial hypertension, the subdural space may be more easily drained and irrigated after collapsing the cerebral hemisphere by removing 25 or 30 cc of fluid from the lumbar thecal sac, as suggested by Kahn[10] After the pus has been thoroughly removed and subsequent irrigation fluid returns clear from all directions over the hemisphere, a small soft rubber catheter is introduced into the subdural space through each burr hole

If interhemispheral subdural suppuration is suspected or found, cranial openings should be made as near to the midline as possible Keith and McKenzie[7] have advocated removal of a long narrow paramedian strip of bone for effective drainage of the sagittal fissure This was carried out in Case 4 of our series at a secondary operation More recently, List[8] has accomplished drainage of the longitudinal fissure by means of multiple burr holes in the parasagittal region, in the frontal, parietal and occipital areas

Although there was very little drainage through the indwelling catheters, they served as a means of injecting penicillin into the subdural space in two of our four cases Penicillin in concentration of 1,000 units per cc was used In Case 2, 15,000 units were injected daily for two days, and 10,000 units daily for five days In Case 3, 10,000 units were left in at the time of operation, and 10,000 units were instilled daily for four days, and 5,000 units on the three succeeding days Case 1, treated in 1946, prior to the publishing of the works of Schiller Cairns and Russell,[*] did not receive subdural instillation of penicillin Case 4, our most recent patient, likewise was not treated with instillation of penicillin in the subdural space This patient made an apparently good recovery from a left subdural abscess, however, he succumbed to a collection of pus over the opposite hemisphere which had spread from the orbital surface of the left frontal lobe to the longitudinal fissure beneath the falx and over the right hemisphere. Both of the patients who had no penicillin instilled into the subdural space had convulsions previous to drainage, however, only one had convulsions in the immediate postoperative period and then for only two days The remaining two patients who had instillation of subdural penicillin both had preoperative and postoperative convulsions, the postoperative convulsions being troublesome for three days in one and five days in the other Although the number of cases involved is too small to draw any conclusions, in view of the fact that concentrated penicillin solution in contact with the cerebral cortex in itself may produce convulsions, one wonders whether or not this procedure is either necessary or justifiable. It is not beyond the realm of possibility that intramuscular penicillin in sufficient dosages and adequate sulfonamide therapy would prove sufficient to prevent the spread of the infection This question is certainly deserving of further consideration Schiller Cairns and Russell[*] have advocated injecting large quantities of penicillin solution containing 500 units of penicillin per cc. into the subdural space every three hours for several days. Gurdjian and Webster[5] and List[*] recommend the instillation of about 30 to 50,000 units of penicillin in a smaller volume of fluid three times daily

The details of the dosage and duration of systemic administration of antibiotics and sulfonamides in our cases are depicted in Table VI Careful attention to the general care is highly essential inasmuch as these patients are critically ill and in need of competent nursing adequate diet, blood transfusions and general supportive measures

The importance of removal of the original focus of infection, if possible at the same time as the surgical management of the intracranial complication, cannot be too strongly emphasized Empyema of the frontal sinuses and osteomyelitis of the frontal bone should be eradicated In two of our four cases the subdural abscess was drained and bilateral frontal sinusectomy with resection of an additional portion of the frontal bone was accomplished in one sitting In one instance left frontal sinusectomy with exposure of the dura was carried out 22 hours previous to drainage of the subdural abscess, in this particular instance the diagnosis was not entirely clear previous to sinus operation, and the possibility of an epidural abscess was held to be most likely In one case previous frontal sinus surgery, which had been too conservative, was done sometime prior to the drainage of the subdural suppuration, this patient was later subjected to complete eradication of his frontal sinuses in his convalescent period

SEQUELAE

Three of the four patients in this series survived The follow-up periods are five years, two years and one year, respectively The three living patients are all gainfully employed, and their position and station in life have not been materially altered The most undesirable sequela among these patients thus far has been convulsive seizures, all had convulsions prior to their operative treatment All three survivors had Jacksonian seizures in the immediate postoperative period Case 1, who has now been followed for five years, is well controlled with anticonvulsant therapy and has had no seizures in 10 months Case 2 has had no generalized seizures since institution of anticonvulsant therapy and occasionally has a mild Jacksonian seizure implicating the right face, lasting a few minutes at a time, at a frequency of once a month Case 3 is well controlled with anticonvulsant drugs and has an occasional mild Jacksonian seizure implicating the right face and arm, lasting a few minutes at a time, and recurring no more frequently than every two months The frequency of a residual convulsive state is understandable in view of the cortical cicatrization which takes place secondary to the inflammatory reaction In the future it may be of interest to clarify the role of the instillation of penicillin into the subdural space in producing an increased frequency of convulsions On the other hand, earlier diagnosis allowing surgical intervention, when the pus is limited to the frontal pole perhaps offers the best chance of preventing this undesirable sequela

SUMMARY AND CONCLUSIONS

Acute subdural abscess is a serious, though infrequent, complication of suppurative frontal sinusitis which constitutes a distinct clinical and pathological entity, the diagnosis of which is not difficult if one is cognizant of the possibility

The diagnosis pathogenesis and treatment of the condition is reviewed and our experience with four cases is reported The sudden onset of Jacksonian convulsions and focal neurologic signs in the presence of acute suppurative frontal sinusitis usually indicate the presence of a subdural abscess The abscess may be a fulminating and rapidly fatal infection It is usually limited in the beginning to one side but, if undrained, tends to spread over the entire cerebral hemisphere and in the late stages to the opposite side. Early diagnosis and treatment are necessary for a successful result Treatment consists of massive administration of antibiotics and sulfonamides with immediate evacuation of the purulent collection through strategically placed burr openings and instillation of penicillin into the subdural cavity The importance of bilateral exploration is stressed Unfortunately convulsive seizures are all too often a serious sequela.

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THE PRESENT STATUS OF GLOBUS HYSTERICUS [*]

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It is my opinion that so-called 'globus hystericus" has played a very important part in our practice in the field of otolaryngology and bronchoesophagology, and that too little time has been spent in the diagnosis and treatment of these patients It is agreed that the difficulty in differentiating between functional disturbances and organic disease at the level of the upper esophagus has contributed to this apparent state of confusion The lack of interest manifested by physicians in diseases in the upper end of the esophagus pharynx and larynx, and their tendency to ascribe symptoms of an indefinite character to functional or emotional disturbances has been an added factor in stimulating my investigation of the subject.

It is believed by most authors that the symptom complex of 'globus hystericus' is based upon certain mental stigmata in which the chief clinical symptoms are headaches, often severe, some pains, which are centered in the small of the back spells of laughing and crying which are uncontrollable, poor sleeping habits with terrible dreams, irregular movements of the body kicking of the legs throwing the head from side to side rolling on the bed and a feeling of "full ness or "choking" in the throat, which leads to the term of 'globus hystericus ' Patients do not, however, go into coma, nor do they exhibit any convulsions

Much was written in the early days about the special types of 'psychoneurosis , and some of the authors emphasized the disorders of the muscles and the muscle fibres, especially in their relationship to the complex chemistry of the muscle

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itself, particularly in its relationship to creatine and creatinine metabolism If some of the later writings upon this subject are to be considered important, and if we are to consider muscle spasm as part of this phenomena, then it must be understood that the *disorders* of the muscle must be taken into consideration

Another phase of the subject which is very interesting is the clinical facts about the "hysteria" reported by various authors It is considered that there are three forms of hysteria primary, secondary and tertiary, according to whether the manifestations are associated directly with an uncontrolled emotional tone, a discomfort of any description, or with the expectation of discomfort, respectively

"Globus hystericus" is most likely classified as *a* regressive and *b* secondary, and the symptoms arise in an atmosphere associated with discomfort in the broadest sense of the word and in any part of the body

It was thought in the beginning that this condition was more common in the female, particularly after puberty, and that hysteria itself reacted with abnormal ego contricity—an ego that demanded attention The hysterical patient wants to be noticed without interference of his personal habits An outstanding feature of an hysterical patient is his apparent emotional placidity and general air of detachment from his surroundings He is interested in his symptoms, but his interest is rather that of an onlooker than a participant He is invariably courteous, but is never anxious or disturbed

Now, as you can see from the foregoing resume, there are certain stigmata to which we attach the term "globus hystericus" There seems to be a realm of facts to support the idea that a true functional "globus hystericus" does exist, however, in mild cases these patients are satisfactorily treated by either the general practitioner or the internist who sees them first, and the majority are not referred to the endoscopist or the otolaryngologist (speaking personally, it is a rare happening that a case with marked functional "globus hystericus" is referred to me for treatment), therefore, the diagnosis which has been established by the aforementioned information can be properly treated only by one specializing in psychiatry or nervous disorders.

It is my experience that organic disease produces a symptom complex which can be referred to as globus hystericus ' Here I am referring to patients under my own supervision who complain of a lump in the throat" as their most outstanding symptom — and the phrase is usually forced upon the patient by the physician because the patient himself is unable to describe the vague sensation which he feels This single complaint has been found to occur in primary infections of the pharynx or upper esophagus It has also occurred in patients with diabetes, rectal polyps G I upsets due to dietetic errors, diseases of the thyroid gland, elongated uvula telangiectatic tumors of the vocal cords, allergies, trench mouth of the gums, tuberculosis, thyroglossal-duct cysts, lingual goiter, long styloid process ossifications of the ligaments, carcinoma of the larynx, pharynx and upper esophagus and eye strain corrected by glasses In every case this single symptom has disappeared after adequate treatment of the organic disease It, therefore, appears that many cases diagnosed as globus hystericus ' with the sole complaint of a 'lump in the throat" and without any of the other associated stigmata of "hystericus' respond to treatment of their organic disease. Can such cases then be classified with those in the realm of 'functional disorders? '

It is now that I wish to discuss my own experience with the patients who have been referred to me by other physicians because these patients have a lump in their throat ' These people are put well at ease before the examination begins, and a careful history is obtained regarding the present illness and all factors in the past history of the patient which should have a bearing on the outcome of the interview It is true that in many of these cases there have never been any other stigmata of disease except the one symptom of a lump in the throat ' The patient is very carefully interrogated regarding his emotional disturbances such as hostility anger rage, resentment fear and jealousies Other possible emotional factors are domestic troubles, sexual difficulties or frustration, forms of guilt, financial worries, frustrated ambitions, discouragement for any reason, fright or worry These suspicions must be removed as a causative factor in the patient's "symptom" before an inquiry is made regarding the nutrition of the patient, whether or not they have easy fatigue or exhaustion, whether some accident or trauma has had to do with their present illness, etc Although I am sure that my approach to the problem is not so good as that which could be performed by many general practitioners, internists or psychiatrists, I believe that in many of these cases I have been successful in obtaining enough insight into the patient's emotional stability to form an opinion as to whether the patient should be treated as a very mild type of hysterical individual, or whether, if my findings should disclose organic disease, he could be treated without being referred for special psychiatric therapy

There has been another interesting problem which has confronted me regarding these patients I have to report on 98 individuals who have come to me with the symptom of a "lump in the throat" Most of these have been diagnosed as a mild type of "hysteria" The others have been found to have organic disease which has been treated adequately following diagnosis The large group has had X-ray examinations of the neck, which revealed two characteristic phenomena one they have marked hypertrophy of the lingual tonsil, which is very easily seen by indirect examination of the pharynx, and which is confirmed by the lateral X-ray films of the neck, second, they have marked lipping or osteoarthropathy of the anterior borders of the cervical vertebra

At this point I would like to refer to my investigation into this subject and in a small way attempt to show that *marked lipping of the cervical vertebra with the so-called inflammatory reaction in the soft tissues anterior to the lipping may be the causative factor in setting off the trigger mechanism which produces the "symptom"* I have several slides which have been prepared from this large series of nonorganic cases

The few shown here are characteristic of the anterior lipping and in my opinion produce a serious problem in the diagnosis and treatment of "globus hystericus"

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To me this seems to be as logical an explanation as hyperirritability of the mucous membrane, spasm of the cricopharyngeus muscle, irritability caused by enlarged lymph nodes etc.

My success in treating these patients has been due to the fact that I have been able to establish a true emotional relationship between the patient and myself, so that this lonely symptom of a 'lump in the throat" which the patient originally complained about has disappeared

I believe that we are duty bound as physicians, and particularly as otolaryngologists, to examine these patients thoroughly and treat them according to their needs which of course are determined by careful and complete physical examination

CONCLUSION

"Globus hystericus" or a lump in the throat' can be a symptom of functional disorder, either mild or severe, or of organic disease The diagnosis is based upon a complete history and physical examination. Psychiatric treatment by the physician who is willing to establish a true emotional relationship between the patient and himself Organic diseases should be treated as such A new observation has been discussed and I trust that this brief review of the past will stimulate more activity on this subject in the future

BACTERIOLOGIC AID IN RHINOLOGIC DIAGNOSIS AND TREATMENT IMPROVED CRITERIA*†

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The progress of medicine has run a parallel course with the development of improved methods of diagnosis and treatment The basic sciences especially have contributed much to the origin of newer concepts of disease processes It is the purpose of this communication to show how bacteriologic investigations, done in a simple manner, suitable for office procedure, can improve greatly the understanding of nasal and sinus disease and the indication for therapy

As in other fields, the old standard methods of physical diagnosis in rhinology very often fail to provide the definitive information which is required to establish accurate diagnosis Direct examination of the nose and nasopharynx and transillumination and Roentgen examination of the paranasal sinuses frequently do not reveal the findings needed for a correct evaluation of rhinologic problems

During the past several decades, lavage of the large sinuses has been accepted as a valuable additional diagnostic method Frequent use of this procedure for diagnosis has demonstrated that secretion can be washed out of a maxillary antrum or sphenoid sinus, for instance, even though transillumination and X-rays have shown the sinus to be clear The Roentgen examination has more reliability than transillumination, but both these methods can fail to detect the existence of secretion

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One of the significant manifestations in nasal or sinus disease is a discharge of fluid material or secretion This material, as we all know, may vary considerably in consistency color and amount. It has been my experience to find many micro-organisms in small amounts of mucoid secretion irrigated from sinuses and, on the other hand, no micro-organisms or cellular evidence of infection in large amounts of secretion obtained from sinus lavages, also, I have found the consistency or color of the secretion to be no index of infection thus, the amount and appearance of nasal and sinus secretion *per se* may not predicate infection or indicate degree or kind of infection.

It is true that an obviously purulent infection can be recognized often by direct examination but such a case rarely presents a problem in diagnosis. It is the instance in which the presence of a discharge is mistaken for infected secretion that may lead to erroneous diagnosis and treatment. The designation of mucus or pus should be reserved for characterization only after microscopic examination and culture of the secretion have been made. The term secretion" is used arbitrarily in this discussion to describe nasal and sinus discharge.

One of the reasons for errors in rhinologic diagnosis has been that in the past the term 'infection" has been used loosely and applied inaccurately in the evaluation of various rhinological disturbances To prove the existence of infection, it is not only essential to demonstrate the presence of micro-organisms but also their active multiplication Parenthetically it should also be stated that infections always begin on the surface of the mucus membrane, and if uncontrolled, then the bacteria invade the deeper tissues

In order to emphasize this concept, may I remind you of the simple admonition given to students of clinical microscopy that a cloudy urine doesn t necessarily imply the presence of white blood cells or infection. A diagnosis of infectious or bacterial meningitis for instance, is also made only if a micro-organism is isolated and cytologic and chemical changes occur in the fluid

The problem most commonly encountered in rhinologic diagnosis is the differentiation of infections from noninfectious disorders of the nose and sinuses Many of these noninfectious conditions belong to the broad category of vasomotor rhinitis Allergic rhinitis comprises a significant entity in this category Skin and other kinds of testing for pollen and other types of sensitizing agents has proved valuable in distinguishing allergic rhinitis from other diseases of the nose and sinuses It is now being recognized that in a large number of patients suffering from vasomotor rhinitis, the etiologic factors may be physical, psychological or constitutional The use of local medicaments may also be responsible for vasomotor reactions

Bacteriologic and cytologic examinations of secretion obtained from the nasal cavities and paranasal sinuses are usually valuable and frequently necessary to establish clearly the presence of an infectious or vasomotor disturbance They should be regarded as principal diagnostic procedures It should be realized that the accuracy of such diagnostic criteria cannot be expected to be greater than any ordinary laboratory procedure, however, it has been my experience that this approach to the diagnosis of rhinologic disease has proved to be much more helpful than the standard method of physical examination alone

It may be stated that routine cultures of nasal and sinus secretions together with microscopic examinations of these secretions provide *1* a precise diagnostic method to differentiate specific infections and vasomotor rhinitis, *2* a rational basis for the use of specific antibiotic and chemical therapy, and *3* consequently, improved diagnostic criteria for nasal and sinus disease

The technique for the bacteriologic and microscopic study of nasal and sinus secretions which has been found to be most effective in office or routine hospital practice has been as follows A sterile platinum loop is applied to the reactive mucous membrane in the sphenoethmoidal recess, the middle meatus and over the turbinates for the removal of secretion

If the discharge is copious, a sterile capillary pipette is used for this purpose. It is believed that the platinum loop is far superior to a cotton applicator, which is liable to cause gagging and contamination from nasopharyngeal secretion When a nasopharyngeal culture is desired, a curved large loop is carefully passed through the mouth into the nasopharynx avoiding contamination Secretion from a sinus is collected in a basin under 'surgically clean" conditions and is aspirated into a sterile capillary pipette for bacteriologic study

Secretions are spread on clean glass slides for microscopic study and are stained with Wright stain for routine purposes Such spreads permit microscopic identification of micro-organisms, when present, and cellular elements If desired, the Gram stain should be made to differentiate the Gram positive and negative micro-organisms The Hansel stain is of value for the clearer delineation of the eosinophile.

All cultures are made routinely on blood agar plates alone Not only are micro-organisms easily grown on blood agar but the opportunity for quantitative estimation which is so important, is also afforded by this method

The data which should be obtained in the microscopic examination of nasal and sinus secretion is the following *1* the number and kinds of micro-organisms, *2* the amount of mucus, and *3* the types of cells In infections as a rule in contradistinction to vasomotor disturbances bacteria can be found readily on spreads and can be correlated usually with a pathogenic micro-organism on culture Neutrophilic polymorphonuclear cells are also commonly found in large numbers Mucus is a prominent finding in allergic and vasomotor rhinitis, while it tends to be lacking in infections The belief is that active growth of bacteria destroys mucus Although allergic and vasomotor rhinitis may exist without eosinophiles appearing in the nasal secretion their presence in moderate and in especially large numbers strongly suggests such a diagnosis particularly if no micro-organisms are seen in the spread It should be mentioned that a severe eosinophilic rhinitis can produce secretion with purulent characteristics

The information which should be sought in the culture is whether the micro-organism which has been obtained from the nose or sinus is pathogenic or nonpathogenic and the quantitative estimation of such micro-organisms Inasmuch as pneumococci, hemolytic streptococci, hemophilus influenzae and parainfluenzae and Klebsiella pneumoniae are found very rarely in the normal nose or sinus, even in very small numbers, isolation of any of these micro-organisms from the secretion in the nasal cavity or irrigated from a sinus strongly suggests the presence of infection Moderate or large growth on culture of staphylococcus aureus A, streptococcus viridans, streptococcus nonhemolyticus, proteus bacillus, pseudomonas aeruginosa also suggests the existence of infection, particularly if found on repeated occasions The probability of infection is further substantiated if in addition spreads of stained secretion show similar micro-organisms and neutrophiles It should be mentioned that these micro-organisms can be isolated from nasopharynges which show no evidence of infection In other words, these potentially pathogenic micro-organisms are present in the normal nasopharynx It is my belief that the nasopharynx is the carrier-focus of pathogenic micro-organisms which spread into the nose (and also into the tracheobronchial tree) and cause infections when the antibacterial barriers are broken by lowered resistance of the nasal mucosa

On the other hand, staphylococcus albus, staphylococcus aureus B, diphtheroids, Neisseria pharynges and staphylococcus aureus A in very small numbers are present in the normal nose and as a rule are not associated with infection, thus, if any of these micro-organisms, alone or in combination, are cultured from nasal or sinus secretion, it is unlikely that infection exists If spreads of such secretion show no micro-organisms, or just a few, and a large amount of mucus, then the evidence is strong that one is dealing with a vasomotor disorder[1]

The causative agent of a sinus infection occasionally can be a micro-organism which is usually nonpathogenic For instance, I have recently treated an acute frontal sinusitis due to proteus vulgaris Before such a micro-organism is accepted as the cause of the infection it should be repeatedly isolated and be identified by microscopic examination of a spread of the secretion In the patient mentioned the Gram negative bacilli were present in large numbers in the direct smear

A sinus infection the secretion of which shows Gram positive cocci on spreads but fails to grow any colonies on repeated cultures should suggest the possibility of an anaerobic micro-organism such as anaerobic streptococcus hemolyticus I have observed an anaerobic streptococcal infection of a maxillary antrum associated with erythema nodosum These lesions disappeared the sedimentation rate and the temperature, which had been elevated, returned to normal and systemic manifestations of the illness subsided with the cure of the sinus infection

Thus, correlation of the kind and number of micro-organisms found on examination of nasal spreads with those of cultures made from the same secretion can provide pertinent and significant information as to the nature of the rhinologic status The interpretaton of the bacteriologic and cytologic findings of the nose and sinuses in health and disease is outlined in the following table

TABLE 1
INTERPRETATION OF BACTERIOLOGIC AND CYTOLOGIC FINDINGS

	Bacteriology	Cytology
Normal Nose	Nonpathogens 0 to 2+ colonies	No or few micro-organisms Mucus 0 to 1+ Polys. 0 to 1+
Vasomotor (Allergic) Rhinitis and Sinusitis	Nonpathogens 0 to 2+ colonies	No or few micro-organisms Mucus 3 to 4+ Usually eosins to 4+ Occns. polys alone
Nasal and Sinus Infections	Pathogens 1 to 4+ colonies	Micro-organisms often 3 to 4+ Mucus 0 to 2+ Polys to 4+
Vasomotor (Allergic) Rhinitis with Infection	Pathogens 1 to 4+ colonies	Micro-organisms often 3 to 4+ Mucus 3 to 4+ Usually eosins to 4+ Polys to 4+

1+ = Small 2+ = Small to Moderate 3+ = Moderate 4+ = Large

In view of the number of antibiotics available and new antibiotics constantly appearing, bacteriologic investigations with susceptibility tests on a routine basis permit the proper utilization of specific antibiotic and chemical therapy This principle is generally accepted in theory but not in practice Although hemolytic streptococci and pneumococci, as a rule, are susceptible to the antibiotics, the staphylococci and the Gram negative bacilli which are found in upper respiratory infections may show considerable variations in susceptibility There is evidence that even the pneumococcus may be occasionally resistant to penicillin[2] Now that dried antibiotic discs are available for such testing, preliminary or approximate information concerning the susceptibility of a microorganism can be obtained with simple facilities and in a short time[3-5] The serial dilution method of testing offers, of course, greater accuracy and should be carried out whenever possible I can recall, for example, a number of staphyloccus aureus A sinus infections which were resistant to penicillin but sensitive to aureomycin, an acute frontal sinusitis due to hemophilus influenzae which responded to therapy after the administration of sulfadiazine and streptomycin, and the acute frontal sinusitis caused by proteus vulgaris mentioned above, which reacted favorably to chloromycetin but not to aureomycin

Precision in diagnosis of nasal and sinus infections is also necessary to restore the problem of foci of infection of these areas on an acceptable basis In the past few decades, the relationship of foci of infection of the paranasal sinuses to systemic diseases has been in a state of confusion The main reason for this, in my opinion, has been the incomplete and inadequate information as to the actual presence or absence of infection Thorough correlation of bacteriologic and cytologic examinations along the lines indicated will greatly help to clarify the relationship that does exist between nasal and sinus infections and systemic diseases

SUMMARY

It is suggested that bacteriologic and microscopic study of nasal and sinus secretion should be used as major criteria in the determination of nasal and sinus disease A correlation of these two investigative procedures leads to a more precise diagnostic evaluation This method can be very helpful in differentiating the infectious from the noninfectious diseases of the nose and sinuses Susceptibility tests with antibiotic discs on isolated micro-organisms provide a rapid means to determine specific antibiotic and chemical therapy

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BLEEDING FOLLOWING TONSILLECTOMY [*][†]

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Tonsillectomy is the most frequent operation in modern surgery In spite of the many advances made in anesthesia, in fluid and electrolyte physiology, and in surgical technique, the one great unconquered hazard of tonsillectomy is bleeding

An analysis of the cases of bleeding following tonsillectomy reveals two periods of high incidence of such bleeding a period immediately following surgery, and a period usually five to eight days later This permits classification of such bleeding as *a* primary bleeding, and *b* secondary (late) bleeding The causes and management of these two types of bleeding are different and unrelated

PRIMARY BLEEDING

Primary bleeding occurs within the first 24 to 48 hours postoperatively but may persist throughout the period of convalescence unless checked In the majority of instances, primary bleeding is due to inadequate surgical hemostasis at the time of operation, to the loss of a ligature from the throat during the reaction period or soon thereafter, or to some constitutional disorder which interferes with the proper clotting of blood The first two causes are almost always due to faulty surgical technique, and the last named may be obviated by a proper preoperative history and laboratory examination of the patient In the author's experience, primary bleeding is at least as common from the adenoid fossa as from the tonsillar fossae, whereas secondary (late) bleeding is preponderantly from the tonsillar fossae

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[*] Read at the meeting of the Southern Section American Laryngological Rhinological and Otological Society Inc Atlanta, Ga Jan 13 1952

[†] From the Department of Otolaryngology of the University of Maryland School of Medicine

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SECONDARY BLEEDING

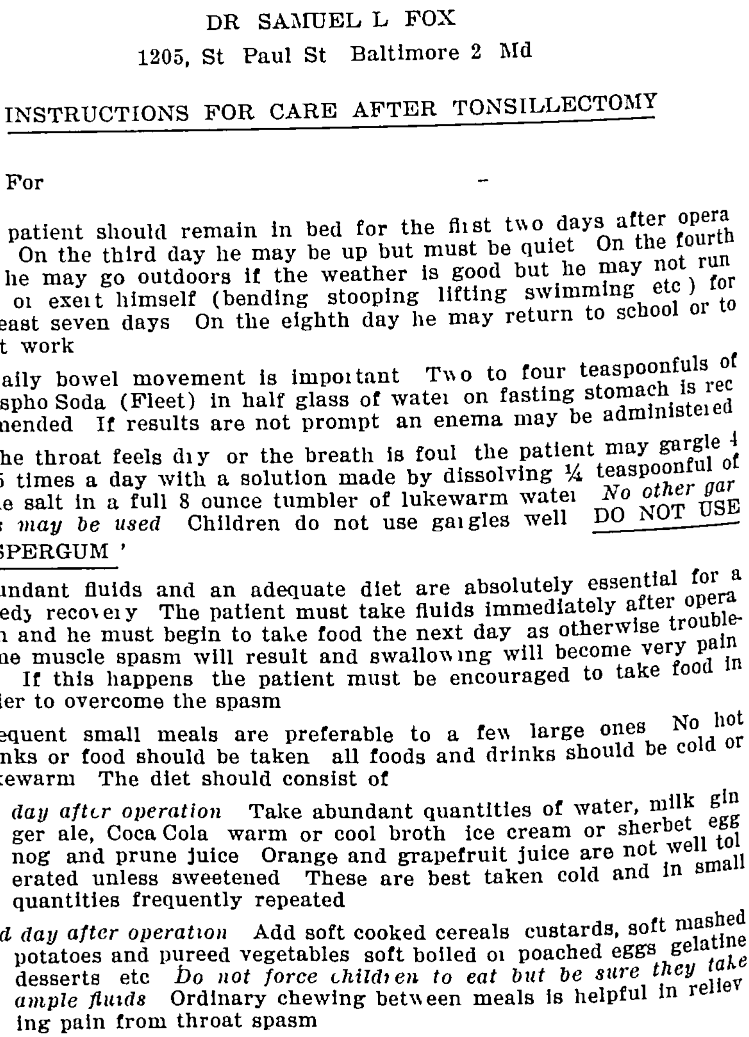
Secondary bleeding occurs from two to 10 days postoperatively, with the highest incidence on the fifth and sixth days Predisposing factors and direct causes for secondary (late) hemorrhage include acute febrile diseases occurring during convalescence, dietary deficiencies, particularly vitamins and proteins, hypertension, local infection, local trauma blood dyscrasias, and certain drugs, notably aspirin administered either locally or systemically during the convalescence

In tonsillectomy and adenoidectomy sizeable areas are left raw and uncovered and healing by secondary intention must take place. Superficial infection by invasion of the bacterial flora of the mouth and throat is the rule The reaction to bacterial invasion plus the normal hemorrhagic and serous exudation which occur on such a raw surface, produces a crust which finally covers the entire surface of the wounds If this crust remained undisturbed the problem of secondary bleeding would be minimized however the crust is continually under stress and strain by the normal movement of the regional muscles Granulation tissue promptly begins to form beneath the crust, growing from below upward, and results in displacement of the crust in from seven to 10 days As the crust slowly disintegrates or becomes dislodged the granulation tissue is often exposed, and hemorrhage may result As mucous membrane proliferates to cover this granulating surface the possibility of bleeding from dislodgment of the crust is reduced accordingly

Attempts to produce *per primum* healing by sewing together the pillars, or by suturing the superior plica across the fossa, have all come to naught The sutures are soon torn out by the movements of the pharyngeal muscles and during the interim the patient suffers severe pain on attempted swallowing or talking

It is obvious that every attempt should be made to control acute febrile diseases local infection hypertension and blood dyscrasias and to avoid local trauma during the convalescence The patient must be impressed with the importance of obtaining all necessary elements of diet, and of avoiding any harmful drugs or measures during the convalescence The need for an adequate protein intake during the postoperative period cannot be overemphasized[11] For this purpose the author provides the patient or parent with detailed printed instructions immediately following the operation (see Fig 1)

FIGURE 1



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INSTRUCTIONS FOR CARE AFTER TONSILLECTOMY

For –

1 The patient should remain in bed for the first two days after operation On the third day he may be up but must be quiet On the fourth day he may go outdoors if the weather is good but he may not run play or exert himself (bending stooping lifting swimming etc) for at least seven days On the eighth day he may return to school or to light work

2 A daily bowel movement is important Two to four teaspoonfuls of Phospho Soda (Fleet) in half glass of water on fasting stomach is recommended If results are not prompt an enema may be administered

3 If the throat feels dry or the breath is foul the patient may gargle 4 or 5 times a day with a solution made by dissolving ¼ teaspoonful of table salt in a full 8 ounce tumbler of lukewarm water *No other gargles may be used* Children do not use gargles well DO NOT USE 'ASPERGUM '

4 Abundant fluids and an adequate diet are absolutely essential for a speedy recovery The patient must take fluids immediately after operation and he must begin to take food the next day as otherwise troublesome muscle spasm will result and swallowing will become very painful If this happens the patient must be encouraged to take food in order to overcome the spasm

5 Frequent small meals are preferable to a few large ones No hot drinks or food should be taken all foods and drinks should be cold or lukewarm The diet should consist of

1st day after operation Take abundant quantities of water, milk ginger ale, Coca Cola warm or cool broth ice cream or sherbet egg nog and prune juice Orange and grapefruit juice are not well tolerated unless sweetened These are best taken cold and in small quantities frequently repeated

2nd day after operation Add soft cooked cereals custards, soft mashed potatoes and pureed vegetables soft boiled or poached eggs gelatine desserts etc *Do not force children to eat but be sure they take ample fluids* Ordinary chewing between meals is helpful in relieving pain from throat spasm

3rd day after operation Cooked meat, if finely cut up and properly chewed may be added to the diet. *In the next four days the diet should gradually return to normal except that dry toast crackers and other similar foods should be avoided*

Highly seasoned and hot foods or drinks and all alcoholic beverages must be avoided for a period of two weeks following operation Beer may be taken in small quantities after one week.

6 Moderate pain in the ears and slight fever (up to 100° F) are common and of no significance. A hot water bottle or heating pad applied over the ears usually affords relief. If severe, constant, throbbing pain should develop in the ear accompanied by fever of over 100° F notify me or call your physician.

7 If any bleeding occurs the patient should sit erect and gargle with a mixture of 1 part of hydrogen peroxide solution and 3 parts cool water Ice may also be sucked. If these measures do not control the bleeding notify me or take the patient back to the hospital in a car without delay

8 The patient should return to my office on at
for examination of the throat and further instructions.

In spite of these measures which are almost universally stressed, the incidence of late tonsillar bleeding is generally acknowledged to be approximately 10 per cent.[1] [2] (In the author's control series the incidence was 9 9 per cent.) In 1945, Singer[4] pointed out that in Austria, where he formerly practiced, late tonsillar bleeding seemed much less common In his experience the only significant difference in the management of the cases on the two continents is the widespread use of aspirin here whereas aminopyrine is the analgesic of choice in Central Europe Neivert[1] pursued Singer's observations and postulated that the high incidence of late bleeding observed in this country was probably due to a salicylate-induced prothrombinemia He attempted to prove that the administration of vitamin K would reduce the incidence of late tonsillar bleeding by preventing such a prothrombinemia. In a series of 283 patients who were given vitamin K along with aspirin following tonsillectomy, he reported a decrease in late hemorrhage from his previous 10 per cent incidence to an incidence of 1 1 per cent

The author began his studies of late tonsillar bleeding immediately after the publication of Neivert's work but was not able to duplicate Neivert's results[3] In subsequent published reports it developed that Neivert was administering moderately large doses of aspirin orally, whereas the author primarily used aspirin in the form of chewing gum This might account for some differences in prothrombin blood levels in the patients in the two series

It is conceded that very large doses of salicylate may reduce the prothrombin level of the blood, and that vitamin K will protect such an individual from such a prothrombin depletion if administered along with the salicylate Quick,[9] however, emphasizes that prothrombinemia becomes clinically significant only if the prothrombin falls below 20 per cent of normal, as it is not until then that the patient is in danger of hemorrhage

It is the author's opinion that most otolaryngologists do not employ aspirin in such large doses after tonsillectomy, but that the vast majority of aspirin prescribed is in the form of aspirin chewing gum It was difficult to conceive that the relatively moderate doses of salicylate ingested during the usual postoperative period could deplete the prothrombin to such an extent as to place otherwise normal patients in danger of hemorrhage

Since the administration of vitamin K along with the indiscriminate use of aspirin chewing gum had no effect whatever on the incidence of late tonsillar bleeding in the author's series, it was felt there must be other causes for such bleeding, and efforts were directed toward establishing possible adverse local effects of such aspirin [3]

Livingston and Neary[7] subsequently reported a small series of 45 tonsillectomies in which prothrombin studies were made Twenty-nine of this group received five to six tablets of aspirin chewing gum daily (approximately 20 gr daily) from the first to the seventh postoperative day There was an incidence of 6 6 per cent of late tonsillar bleeding, and there was no decrease of blood prothrombin in any of the cases A control group of 16 patients received aspirin chewing gum in similar dosage and, in addition, 0 5 mgm of synthetic vitamin K The incidence of late tonsillar bleeding was 6 3 per cent, and again no change in blood prothrombin was noted They concluded that "there is no indication that the routine post tonsillectomy use of chewing gum containing acetylsalicylic acid may give rise to prothrombinopenic hemorrhage or that such use of this gum has any adverse effect on blood prothrombin" We were able to confirm this in three cases of late bleeding in patients who had used aspirin chewing gum indiscriminately and who had taken no vitamin K or any other medication Prothrombin blood levels were determined at the time of the bleeding and all were found to be well within normal limits

Preston[9] reported that in a series extending over a five-year period, secondary tonsillar hemorrhage occurred in from 4.29 to 7 07 per cent of the patients who used aspirin alone, and that in 385 patients to whom he gave vitamin K simultaneously with aspirin, the incidence of late tonsillar bleeding was reduced to 2 08 per cent. It is not entirely clear how much aspirin was given and exactly in what form

None of the above workers described the exact method employed to determine the percentage of late tonsillar bleeding, other than their observations in the office or clinic approximately one week after surgery This point of possible error is stressed since, in our experience, using detailed questionnaires with careful and persistent follow-up by mail and phone, the percentages finally determined showed marked discrepancies with the original figures obtained from our case records alone Our studies were made entirely with the use of such questionnaires (see Fig 2), and cases in which such follow up studies were not possible were omitted from the series.

After studying 246 cases of tonsillectomy, Jones[10] concludes that 'acetylsalicylic acid should not be prescribed for ingestion in sufficient quantities to cause hypoprothrombinemia and should not be prescribed, in any form for local administration following tonsillectomy He also feels that 'adequate vitamins C and K should be prescribed preoperatively and postoperatively to maintain a high prothrombin concentration' and that efforts should be directed at preventing postoperative infection of the operative sites

FIGURE 2

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RE John Doe

Dear Mrs Doe

I am making a survey of all the patients operated upon by me for tonsillectomy and adenoidectomy I would greatly appreciate your answers to the following questions An addressed stamped envelope is enclosed for the return of this questionnaire

Thanking you for your courtesy, I am

Very truly yours,

(Signed) SAMUEL L FOX M D

PLEASE FILL IN THE BLANKS

1 Did any bleeding occur after leaving the hospital? ______

2 If so when did it occur? ______

Was medical attention required? ______

Please describe ______

______

3 Was any lozenge or other medication used? ______ Please describe

______

Did it help? ______

4 Was any Aspergum chewed after operation? ______

If so how many boxes were used? ______

PLEASE RETURN THIS QUESTIONNAIRE IN THE ENCLOSED ENVELOPE

Considering the possible local effect of aspirin upon the wound further, it was found that Ersner *et al*[8] had previously shown that when saliva and blood are mixed, the blood coagulation time is shortened A mixture of saliva blood and aspirin solution, however, showed a definite interference with blood coagulation, and other such strongly acid solutions produced similar effects When aspirin is dissolved in saliva (or other aqueous menstrua) hydrolysis of the compound is quickly effected and free salicylic acid is liberated The author feels that such free acid affects the integrity of the coagulum, digesting and loosening it prematurely The exposed granulating surface is further subjected by the acid-containing saliva to a prolongation of the coagulation time of its exposed and bleeding capillaries Hemorrhage is thus induced and sustained

OUR SERIES

In an effort to determine what factors are most important in the production (and avoidance) of late tonsillar bleeding an extensive study was undertaken, in which the aggregate number of cases studied now totals 1,746 All cases were operated upon by the same method (sharp dissection of the tonsils, and the use of curettes for the adenoids), and the postoperative management was guided by the same set of printed instructions (see Fig 1) The only variations were those instituted for each group, as indicated below, to study a particular problem of the cause of late tonsillar bleeding

Group I consisted of 252 patients who were permitted to use aspirin chewing gum as desired. No other medication was prescribed, except codeine for the adults This constituted the *control group* There were 25 cases of late bleeding an incidence of 9 9 per cent In three of these cases it was possible to have prothrombin determinations made at the time of bleeding The results were normal in all three cases.

Group II consisted of 128 patients who were divided into two subgroups Seventy-eight of these patients were permitted to use aspirin chewing gum as desired, but also took 20 mgm of synthetic vitamin K daily for seven days postoperatively to counteract any prothrombinemia that might have resulted No other medication was prescribed, except codeine for the adults There were eight instances of late bleeding in this group, an incidence of 10 2 per cent The remaining 50 patients were also permitted to use aspirin chewing gum as desired, but they were given 200 mgm of ascorbic acid (vitamin C) daily in addition to the 20 mgm of synthetic vitamin K There were five instances of late bleeding in this group, an incidence of 10 per cent Prothrombinemia was obviously not the answer to the problem

Group III consisted of 576 patients who did not use aspirin chewing gum at all No vitamin K or vitamin C was given, but codeine was prescribed for the adults No other medication was prescribed or forbidden There were eight cases of late bleeding in this group, an incidence of 1 3 per cent This confirmed our belief that the principal cause of secondary bleeding is due to local and not to constitutional effects

Group IV consisted of 202 patients who did not use aspirin chewing gum No vitamin K or vitamin C was taken, but codeine was prescribed for the adults In addition, they were encouraged to use a lozenge containing tyrothricin and a local anesthetic agent* during the postoperative period There were two cases of late bleeding, an incidence of 0 99 per cent

Group V consisted of 419 patients who did not use aspirin chewing gum No vitamin K or vitamin C was taken, but codeine was prescribed for the adults In addition, all patients were given an intramuscular injection of 300,000 units of procaine-penicillin immediately postoperatively (during the reaction period) and on the morning following operation There were four instances of late bleeding in this group, an incidence of 0 95 per cent

Group VI consisted of 167 patients who were managed exactly as those in Group V with the exception that they used a tyrothricin anesthetic lozenge* freely during the postoperative period. There were three cases of late bleeding, an incidence of 1.8 per cent.

At present, studies are being conducted on the effect of sulfathiazole gum on post-tonsillectomy bleeding.* The use of penicillin and aureomycin in lozenge or chewing gum form has been tried but abandoned because of the large number of local reactions, many of which were very severe.

TABLE 1 SECONDARY BLEEDING AFTER TONSILLECTOMY

Group		Conditions of Series	Total Cases	No Cases Bleeding	Percentage Bleeding
Group I		Control group Aspergum *ad lib* No vitamin K or C	252	35	9.9
Group II	*a*	Aspergum *ad lib* Vitamin K	78	8	10.2
	b	Aspergum *ad lib* Vitamin K Vitamin C	50	5	10.0
Group III		No aspergum No vitamin K or C	576	8	1.3
Group IV		No aspergum No vitamin K or C Tyrothricin lozenges *ad lib*	203	2	0.99
Group V		No aspergum No vitamin K or C Penicillin procaine i.m.	419	4	0.95
Group VI		No aspergum No vitamin K or C Penicillin-procaine i.m Tyrothricin lozenges *ad lib*	167	3	1.8

SUMMARY AND CONCLUSIONS.

1. A series of 1,746 consecutive cases of tonsillectomy has been studied in an effort to determine the causes and the methods of prevention of postoperative bleeding.

The author acknowledges credit to Sharpe and Dohme for supplying "Tyrozets" and to the White Laboratories for supplying "Lozilles" and "Sulfathiazol Gum" for this study. Both of these tyrothricin preparations had a high patient acceptance rating. Amotrocin was also supplied by McNeill Laboratories but was not so acceptable to the patients.

2 Bleeding following tonsillectomy and adenoidectomy may be classified into primary and secondary types The causes and management of primary bleeding and of secondary bleeding are different and unrelated

3 Primary bleeding is almost always due to faulty surgical technique or to some constitutional disorder which interferes with the proper clotting of blood Secondary (late) bleeding results largely from secondary infection of the wound, local trauma to the operative site or from the effects of certain drugs, notably aspirin

4 The simultaneous administration of vitamin K (with or without vitamin C) while using aspirin chewing gum effected no decrease in the incidence of secondary hemorrhage in this series, whereas the elimination of the use of aspirin chewing gum during the postoperative period caused the incidence of late tonsillar bleeding to be reduced from 9 9 to 1 3 per cent

5 Whereas it is conceded that very large doses of aspirin or other salicylates may reduce the prothrombin level of the blood, and that the simultaneous administration of vitamin K will protect against such a prothrombin depletion, it is felt that most otolaryngologists do not employ aspirin in such large doses after tonsillectomy but rely rather on the use of aspirin chewing gum This is thought to exert an adverse local effect upon the coagulum covering the wounds

6 The use of tyrothricin-anesthetic lozenges postoperatively has had no effect in reducing late tonsillar bleeding but has provided a measure of comfort to the patient and has visibly reduced secondary infection of the operative wounds

7 The parenteral administration of long-acting procaine-penicillin has produced a possible further slight reduction in the incidence of late tonsillar bleeding (0 95 per cent) and has reduced postoperative sequela and complications

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TREATMENT OF HYPERPLASTIC SINUSITIS *†

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The problem of treatment in patients with hyperplastic sinusitis has proven to be a real challenge from the earliest rhinologist down to the present day specialist The various theories of etiology and causative agents are legion and the story is replete with failures to cure or alleviate the symptoms of this annoying ailment Numerous scientific treatises have been written extolling the virtues of therapeutic skills ranging from injections of dust extracts to radical sinus surgery without taking full cognizance of one of the fundamental factors in the pathogenesis of this common disease process, namely, bacterial hypersensitivity It is generally known that there are two schools of thought on the etiology of hyperplastic sinusitis and both groups have their outstanding proponents One school believes that the nonbacterial allergens are the primary factors and that infection is a secondary development The other maintains that the hyperplastic changes are due to a primary bacterial infection which acts as the allergenic agent My observations support the latter view

Most authorities agree that between 70 and 80 per cent of all cases of chronic sinusitis have allergy as their basic pathology and without adequate attention to this important factor the treatment in these cases is destined to failure The atopic or nonbacterial allergies have been carefully and thoroughly studied in reference to the sinus tract by Hansel[1] and others but there is a paucity of fundamental clinical data on bacterial hypersensitivity and the important part it plays in the pathogenesis of chronic hyperplastic sinusitis[2]

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Goodale,[3] as early as 1916, observed sensitivity to bacteria in the sinus tract and regarded it as an allergic manifestation He felt that an allergic individual who shows negative skin tests is sensitive to bacteria

It is common knowledge that allergy to bacterial protein does occur and this phenomenon is connected with many diseases such as streptococcal infections, rheumatic fever undulant fever, typhoid fever, and others but is best known in tuberculosis because of the discovery of the allergic reaction in the skin of those infected by tubercle bacillus

Zinsser[4] has stated that in allergy to bacterial infection the body is sensitized by antigenic substances which are absorbed from any focus in which bacteria react with inflammatory tissues and as a result the body is rendered sensitive to contact with these same autolytic products whether they are absorbed from a chronically existing focus or from an identical infection subsequently acquired

There are many physicians who do not accept hypersensitivity to infecting bacteria as an explanation of pathologic changes such as hyperplastic sinusitis because the skin reactions obtained with bacterial products frequently are of a delayed and inflammatory nature instead of the immediate urticarial type obtained with simple protein extracts There are others who believe that a patient with focal infections in his teeth tonsils, sinuses or prostate acquires a sensitivity to the bacterial protein which is similar to that of nonbacterial allergens and that these infecting bacteria and their products alone may cause allergic inflammatory reactions This type of allergic response repeated at frequent intervals can produce hyperplastic sinusitis, particularly if the micro-organisms are embedded in the membranes of the sinuses Kistler has demonstrated bacteria in hyperplastic sinus mucosa by microscopic methods as often as by cultural methods and he found most of the bacteria deep in the tissue near the periosteum becoming fewer toward the epithelial surface

Grove and Cooke[5] feel that hyperplastic sinusitis is caused solely by infection which produces a special pathologic response conditioned by the allergic constitution of the patient Grove and Farrior[6] found bacteria in 80 per cent of the hyperplastic ethmoid and sphenoid membranes at operation, and 96 per cent of the hyperplastic maxillary sinus membranes showed bacterial growth Grove states that in his experience almost 100 per cent of the pathologic manifestations of sinusitis are of the hyperplastic or thickened membrane type

Schenck[7] made the observation that allergic ethmoidal tissue cannot combat infection adequately and chronic infection which favors bacterial sensitivity results

In hyperplastic sinusitis the stroma may contain an abundance of migratory cells polymorphonuclears, lymphocytes and plasma cells, and with allergy as a prominent factor a varying percentage of eosinophiles will be present The cellular elements are usually situated around the veins and lymphatics, producing a periphlebitis and perilymphangitis These inflammatory processes result in obstruction of these respective vessels, causing a loss of fluid into the tissues, which distends the stroma of the tunica propria This, in turn, is followed by various degenerative changes in the surface epithelium and glands with distension of the tissues and polyp formation

A chronic inflammatory process in the sinuses will show an increased number of eosinophiles, but Eggston[8] states that their presence does not necessarily indicate allergy in the ordinary sense of the word, he feels that if the term is broadened to include bacterial allergy it may prove the argument that their presence means allergy

Bacterial allergy should be looked upon as an increased alertness of the body cells toward bacilli and bacillary protein developed as a part of specific resistance, but only necessary until such time as immunity can be established Following bacterial invasion the body seeks to protect itself against bacterial substances by the production of antibodies The bacterial substances chemically are cell body proteins including endo- and exotoxins, other nitrogenous products, and carbohydrates The immune bodies include agglutinins, antitoxins, precipitins and in response to bacterial protein substances, there are created important antibodies concerned with bacterial allergy of the tuberculin type. The general idea seems to be that allergy is a phase in the direction of immunity and the greater the sensitivity the higher the immunity

Kolmer* states that allergy to bacteria or their products is important in the mechanism of infection and immunity

Certainly the trend today in practitioners and specialists alike is to ignore the rôle of immunity in the resistance of the individual to respiratory infections and treat each attack of major or minor severity with chemotherapy or antibiotics This not only deprives the patient of nature's most potent weapon to combat infection, but also exposes many of the allergic individuals to antibiotic sensitivity, occasionally making the treatment worse than the disease.

The immunity produced by a moderately severe respiratory infection may last from a few weeks to several months and give protection against other similar bacterial infections for varying periods of time, depending upon the type and virulence of the organisms

Because of the tendency of the medical profession to treat so many respiratory infections with antibiotics, it seems pertinent to emphasize again the value and virtues of stimulating the patient's own defenses by means of autogenous vaccines

The patients in this study comprise a group with allergic backgrounds or family histories of allergy and are either not skin sensitive to the ordinary allergens — inhalants, foods and pollen, or whose symptoms of recurring sinusitis are not alleviated by controlling these offending substances These are patients in whom primary bacterial infection causes mucosal changes in the sinuses. The reaction to the bacterial protein is an allergic one because of the constitutional tendency of the patient. The respiratory mucosa of the upper and lower tracts have much in common and it is logical to assume that if asthmatic attacks can be controlled by reducing allergic responses in the pulmonary tract with vaccine therapy then many of the allergic reactions in the sinus mucosa might be reduced to a minimum if the proper organisms could be obtained for antigenic activity If these allergic edema reactions can be controlled or minimized by this method, the fundamental pathology of most chronic sinusitis could be checked This study was made in an effort to substantiate this thesis

The complete study of each patient included rhinoscopy, nasopharyngoscopic examination, allergy skin tests, sinus X-rays, and bacteriologic cultures

In this presentation there are 200 patients with respiratory allergy, of whom 133 had hyperplastic mucosal changes in one or more sinuses without evidence of pus formation and 67 who had gross purulent secretion in at least one sinus, in addition to the hyperplastic changes There were 121 adults and 79 children in this series

Bacteria for vaccine preparation for the 200 patients were obtained from the following sources

Middle meatus	144
Sinus mucosa at operation	21
Maxillary sinus irrigation	10
Nasopharynx	9
Adenoids at operation	8
Bronchoscopic aspiration	8

The incidence of bacteria cultured for use in vaccines is as follows

Hemolytic staphylococcus aureus	92
Streptococcus viridans	78
Pneumococcus	75
Hemolytic streptococcus	66
Nonhemolytic staphylococcus aureus	29
Nonhemolytic streptococcus	31
Nonhemolytic staphylococus aureus	29
Hemolytic staphylococcus albus	23
Neisseria catarrhalis	19
Diphtheroids	3
K pneumoniae	1
Proteus	1
Total	459

In discussing the bacteriology of the nose and sinuses, Eggston[8] and Wolff state that normally these structures contain very few bacteria, and their observations indicate that the most important organisms from the pathologic standpoint are the hemolytic streptococci, hemolytic staphylococcus aureus, anaerobic streptococci and pneumococci

Castellani, in 1905 showed that when two organisms were injected into an animal simultaneously the antibody response to each organism was equal to that produced by injection of the individual organisms A good general principle to follow in the preparation of mixed autogenous vaccines is that they should contain as few different bacteria as possible and should include only those which are known or suspected to be pathogenic

There were 30 patients in this series who had a pure culture of one organism The bacteria found in pure culture were in this order of frequency

Hemolytic staphylococcus aureus	12
Beta hemolytic streptococcus	8
Hemolytic staphylococcus albus	6
Streptococcus viridans	2
Pneumococcus	1
Nonhemolytic staphylococcus aureus	1

Two different organisms were cultured and included in vaccines for 89 patients three organisms in 65, four organisms in 14 and five different bacteria were incorporated in the vaccines of two patients

The question has been asked many times concerning these patients as to the advisability of using a stock vaccine, inasmuch as they have a wider spectrum of bacterial proteins and are much easier to obtain That question is answered by stating that one must rely upon clinical experience rather than laboratory observations in determining which type of vaccine to use. Since antigenic qualities do not remain unchanged by artificial cultivation as evidenced by loss of capsules diminution of virulence etc , it is highly advisable that the organisms causing the infection be obtained and included in the vaccine as quickly as possible The existence of serologically specific types of bacteria is well known, and it would require a mixture of from 50 to 60 different strains of various bacteria in a stock vaccine if protection against all the serologic types was desired The use of a properly prepared autogenous vaccine reduces to a minimum the risk of using a different strain and this ability to utilize freshly isolated strains of virulent bacteria unchanged by prolonged cultivation is the main advantage of an autogenous vaccine in addition to the fact that freshly prepared vaccines are more antigenic than old stock ones

The vaccines in this study were prepared by two different methods 110 were prepared by the heat killed method in which the bacteria were rendered nonviable by submerging the bottles containing the filtered suspension of bacteria in a water bath at 60° C for one hour on two successive days, 90 vaccines were prepared by the chemically killed method in which phenol or tricresol is used to inactivate the mixture of bacteria

From each vaccine a dilution of 100,000,000 killed organisms per cubic centimeter and another of 2,000,000,000 per cubic centimeter was made by use of the McFarland nephelometer tubes for comparison Sterility tests were done on all vaccines

Intradermal tests were done routinely with 0 05 cc of the weaker dilution of the vaccine Immediate or delayed positive skin reactions were obtained in 36 3 per cent of the 110 patients who were tested with heat killed vaccines and 77 5 per cent of the 90 patients who were tested with the chemically killed vaccines There are divergent views on the reliability of skin tests with bacterial extracts, and most observers disregard them from a diagnostic standpoint I do the testing routinely to be certain that the vaccine is not too strong for the patient, and in 10 per cent of the chemically killed vaccines I found it necessary to dilute the vaccine from 100,000,000 to 10,000,000 killed organisms per cubic centimeter to prevent local and general reactions The reactions from chemically prepared vaccines are probably due to the toxins which are preserved by this method Benson[10] states that the reactions of intradermal tests in conjunction with the systemic effects of bacterial inoculation form the most reliable guide to vaccine therapy in cases of bacterial hypersensitivity of the respiratory tract.

Successful vaccine therapy in hyperplastic sinusitis requires proper administration, which implies giving the optimum dose to the patient at the optimum interval The optimum dose of vaccine is the amount which produces a favorable reaction, an improvement in the symptoms and maintains the longest interval of improvement. Each subsequent dose is regulated according to the general or local reactions produced by the preceding dose It is my custom to start with 0 05 cc. of the weaker dilution and increase the dose by that amount at five day intervals, which is the period of time that the favorable effect of the preceding dose is just beginning to wear off If reactions occur, and they commonly do with chemically killed vaccines being observed in over 50 per cent of this series, then the same dose is repeated, and if the reaction is severe the dose is reduced Rackemann and Graham showed that successful results with bacterial vaccines were dependent upon the production of definite local reactions to the therapeutic doses and that results were not obtained with vaccines which *failed to produce these local reactions Autogenous* vaccines are as individual as one's personality and treatment with them must be empirical When the patient has received 1 cc. of the weaker dilution the stronger concentration of 2 000 000,000 *organisms* per cubic centimeter is given in a similar manner, starting with 0 05 cc and increasing until 1 cc. is reached

Autogenous vaccine therapy rests on an inadequate basis of experimental evidence but has definitely taken a place among other empirical remedies with a certain amount of specificity in hyperplastic sinusitis Grove reported that 75 per cent of a group who had *antrum window resections* showed mucous membrane sensitivity to their vaccines and often a specificity to one organism when several were recovered Not only could asthma be produced but also marked edematous swelling of the lining membrane, almost obliterating the sinus, and an outpouring of mucus loaded with eosinophiles

Autogenous vaccine therapy in hyperplastic sinusitis is not infrequently doomed to defeat from the outset by failure to incorporate organisms of primary infection because of faulty bacteriologic methods, as well as improper preparation and careless methods of administration

Advocates of autogenous vaccine therapy do not intend to neglect other rational forms of treatment Conditions demanding surgical intervention such as irreversible sinus pathology, suppurative foci and obstructing polyps should be treated surgically and all primary foci of infection should be eradicated or drained

From the complete study of each patient and his response to vaccine therapy a clinical impression was made as to whether his sinus pathology was reversible or irreversible One hundred twenty-eight, or 64 per cent, had hyperplastic changes which were considered to be reversible and 72, or 36 per cent, were thought to have irreversible changes in one or more sinus Of the 72 patients with irreversible changes, only 21 would permit the sinus surgery that was indicated, and the remaining 51 preferred not to have their focal infection removed because of advice received from family physicians or friends who warned against any nasal surgery on the grounds that the patients' symptoms would be made worse This is a common belief among the profession and laity alike and probably founded on the poor results obtained from nasal and sinus surgery prior to the recognition and control of allergy in the pre- and postoperative periods It has been my policy to administer autogenous vaccines and maintain the patient on a strict allergic regime before and after sinus surgery in the hope that the patient's increased antibody response and his decreased allergic reaction to bacterial protein will help protect the new sinus membrane from hyperplastic changes

Of the 21 patients who consented to surgery, 14 had bilateral Caldwell-Luc operations, four had antral window resections, two had bilateral ethmoidectomies, and one patient had a radical frontal sinus operation of the Killian type. All of these patients had excellent clinical results except two of the cases with antral window resections in which diseased hyperplastic membrane remained in the sinuses

Of the 51 patients with irreversible pathology in the sinuses who refused sinus surgery, 37 were clinically improved with autogenous vaccine therapy as long as they received injections at regular intervals. Many of this group were careless about the regularity of their injections and some who missed three or four injections had exacerbations of their symptoms with a lapse of several months six patients had as much trouble as they did prior to any treatment. These observations indicate the importance of eliminating focal infection and the necessity of prolonged regular injections if satisfactory results are desired with autogenous vaccine therapy

Of the 128 patients whose sinus pathology was thought to be reversible, 114 were either improved or markedly improved, 10 were unchanged and four were made worse by their autogenous vaccines

SUMMARY

A group of 200 allergic patients with hyperplastic sinusitis who were treated with autogenous vaccines is presented One hundred seventy were improved or markedly improved, 26 were not improved and four were made worse by this treatment. They ranged in age from 10 months to 74 years and the average period of treatment was 10 months Skin tests with the vaccines were positive in 56 9 percent This study further substantiates the thesis that bacterial hypersensitivity is an important factor in the pathogenesis of hyperplastic sinusitis and that autogenous vaccine therapy is a potent agent in the treatment of this disease

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The 1952-1953 Home Study Courses in the basic sciences related to opththalmology and otolaryngology, offered as a part of the educational program of the American Academy of Ophthalmology and Otolaryngology, will begin on Sept. 1, 1952, and continue for a period of 10 months Detailed information and application forms can be secured from Dr William L. Benedict, executive secretary-treasurer of the Academy, 100 First Avenue Building, Rochester, Minn Registrations should be completed before Aug 15

1952 SUMMER MEETING, VOLTA SPEECH ASSOCIATION FOR THE DEAF

The 1952 Summer meeting of the Volta Speech Association for the Deaf will be held in New England, June 16-20, 1952 Theme 'That the Deaf May Speak.'

The program will begin on June 16 in Northampton, Mass, when the Clarke School will welcome our Association members with a series of demonstrations The Clarke program will end Tuesday at noon and the opening session of the main convention will be held Tuesday evening June 17, at the Hotel Kenmore, 490 Commonwealth Avenue, Boston at 8 p m

The program will continue Wednesday, Thursday and Friday at the Horace Mann School and the Hotel Kenmore

Members may register either in Northampton, Mass or Boston

NATHAN P HARRIS Program Chairman

In Memoriam

LOUIS K GUGGENHEIM, M D,

1884-1952

Dr Louis K Guggenheim died suddenly on March 13, 1952, in his home in Westwood Village, Los Angeles, Calif, from dissecting aneurysm of the thoracic aorta with rupturing into the pericardial sac He was 68 years old

Dr Guggenheim was born in Cincinnati, Ohio, March 3, 1884 He received his medical degree cum laude from Washington University in St Louis, Mo, in 1905 After doing postgraduate work at St Louis City Hospital, Dr Guggenheim went to Vienna where he served as a senior interne from 1906 to 1908, and to Berlin where he served in the same capacity from 1908 to 1909 He frequently returned to Europe for further study in the field of otolaryngology He practiced in St Louis from 1909 to 1936, when he moved to Los Angeles He continued the practice of otolaryngology in Los Angeles until 1950 when he entered the field of psychoanalysis, which he was practicing at the time of his death Dr Guggenheim held the following positions Associate Professor of Otolaryngology, University of Southern California, formerly Assistant Professor of Otolaryngology, Washington

University School of Medicine, formerly Research Associate University of California at Los Angeles

He was a member of Phi Beta Pi National Medical Fraternity, Mu Chapter, Washington University, Fellow of the American Medical Association, the American College of Surgeons, the American Otological Society, the American Laryngological Rhinological and Otological Society, the American Academy of Ophthalmology and Otolaryngology, etc. He was a former staff consultant of St John's Hospital, Santa Monica, Calif, and a former staff member of the Los Angeles County General Hospital, the Los Angeles Eye and Ear Hospital and the Children's Hospital of Los Angeles, where he conducted a hearing clinic from 1937 to 1942 in connection with an almost lifelong research project.

Dr Guggenheim was the author of three scientific books 'Otosclerosis," 'Phylogenesis of the Ear ' and its logical sequel, The Embryology of the Human Ear," which is currently being edited for posthumous publication. He presented his book ' Phylogenesis of the Ear" to all the universities of the world He was also the author of many original articles in his specialty

He leaves his widow, Mrs Eleanor Anita Guggenheim, a daughter, Mrs Mary Ewalt, and a son Dr Paul Guggenheim, of Council Bluffs, Iowa.

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION

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Audicon Models 400 and 415
Manufacturer National Earphone Co Inc, 20 22 Shipman St., Newark 2, N J

Audivox Model Super 67
Manufacturer Audivox, Inc., 259 W 14th St, New York 11, N Y

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Manufacturer Aurex Corp, 1117 N Franklin St., Chicago, Ill

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Manufacturer Beltone Hearing Aid Co, 1450 W 19th St, Chicago, Ill.

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Manufacturer American Sound Products, Inc, 2454 S Michigan Ave, Chicago 16 Ill

Dahlberg Model D-1, Dahlberg Junior Model D-2
Manufacturer The Dahlberg Co, 2730 W Lake St., Chicago 16, Ill

Dysonic Model 1
Manufacturer Dynamic Hearing Aids, 43 Exchange Pl, New York 5, N Y

Electroear Model C
Manufacturer American Earphone Co, Inc, 10 East 43rd St., New York 17, N Y

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Manufacturer Gem Ear Phone Co Inc, 50 W 29th St, New York 1, N Y

Maico Atomeer, Maico UE-Atomeer, Maico Quiet Ear Models G and H, Maico Model J
Manufacturer Maico Co Inc 21 North Third St, Minneapolis 1, Minn

Mears (Crystal and Magnetic) Aurophone Model 200, 1947—Mears Aurophone Model 98

Manufacturer Mears Radio Hearing Device Corp 1 W 34th St. New York, N Y

Micronic Model 303, Micronic Model 'Mercury", Micronic Star Model

Manufacturer Micronic Co 727 Atlantic Ave Boston 11 Mass.

Microtone T5 Audiomatic, Microtone Classic Model T9 Microtone Model T10, Microtone Model T612, Microtone Model 45

Manufacturer Microtone Co Ford Parkway on the Mississippi St. Paul Minn Minneapolis 9 Minn.

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Otarion Model E-4, Otarion Models F-1, F-2 and F-3, Otarion Model G-2

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Silvertone Model 103BM

Manufacturer National Hearing Aid Laboratories, 815 S Hill St., Los Angeles 14, Calif

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Superfonic Hearing Aid

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All of the accepted hearing devices employ vacuum tubes

Accepted Hearing Aids more than five years old have been omitted from this list for brevity

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All of the Accepted hearing devices employ vacuum tubes

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RECENT ADVANCES IN THE SURGICAL TREATMENT OF FACIAL PARALYSIS AND BELL'S PALSY.*

JOSEPH A. SULLIVAN, M.B.,
Toronto, Canada

Otology owes a great debt to the late Sir Charles Ballance, and the late Dr. Arthur Duel, in establishing a definite pattern for surgical interference in this gross and appalling deformity, facial paralysis. As a matter of fact, to these men should be given credit for laying the modern foundation of meticulate temporal bone surgery under magnification which was later followed by the high speed drill technique.

The small amount of pathological material available to illustrate the causes and nature of the various lesions responsible for peripheral facial paralysis is partially due to the essentially harmless nature of the condition. Moreover, in those cases in which the injury, disease or growth responsible for the paralysis have spread to neighboring and more vital structures with fatal results, the florid picture presented by the facial condition has overshadowed the facial paralysis with the result that the opportunity to collect material for detail examination has been overlooked.

Some cases of facial paralysis that have been seen recover spontaneously and this has in the past been responsible for the custom of relying upon any inherent powers of recuperation with which the nerve appears to have been endowed.

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*Read at the meeting of the Southern Section, American Laryngological, Rhinological and Otological Society, Inc., Atlanta, Ga., Jan. 13, 19

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The bony facial canal is an integral part of the pars petrosa throughout its entire course This applies to its embryological development and to its surgical anatomy, therefore, it may be said that it is closely related to pathological changes occurring within the temporal bone It is an established fact that the cellular structure of the temporal bone varies greatly This equally applies to its constituent bony facial canal, the internal aspect of which is the anatomical pathway to the bony area of the bulb and the inferior surface of the petrosal pyramid The cellular character of the canal, varying in direct relation to the progress of invasion from the antrum and the middle ear, is normal or modified by early pathological change Cellular extension from the antrum seldom occurs prior to the second year of life Until that time the normal histological appearance may be considered to be diploic

ANATOMY

It is essential that we trace the course of the facial nerve fibres from the cortex to their distribution to the muscles of the face in order to be able to localize with any certainty the position of a lesion causing facial paralysis It must be kept in mind, however, that it is only surgically possible to combat lesions of this structure which occur in the Fallopian canal

The motor fibres of the VIIth nerve to the facial musculature arise in the pons in a cell column common to all the motor cranial nerves except the hypoglossal nerve and nerves to the eye This facial nucleus included in the basal reflex arc is controlled from the cortex in a manner that has special clinical significance While the corticobulbar tract reaches it undivided, there is a separation of the higher centres controlling each nucleus so that the temporal fibres for the occipitofrontalis, orbicularis oculi and corrugator supercilli are not involved in cortical hemiplegia Starting from the cortex, the motor fibres run down to the seventh nucleus, situated deep in the lower portion of the pons, and they emerge as the motor root at the lower border of the pons, between the olive and restiform body Just before the motor root leaves the pons it is joined by fibres from the third nucleus, which supply the following muscles the orbicularis palpebrarum, corrugator supercilli and the anterior belly of the occipitofrontalis, therefore, lesions occurring in the cortex, or in the course of the fibres to the nucleus, or a little beyond will cause paralysis of the muscles of the face with the exception of these three, a questionable deafness due to paralysis of the stapedius muscle, and no loss of taste in the anterior two-thirds of the tongue There will be no dryness of the mouth as the fibre supply of vasodilator nerve impulses to the submaxillary and sublingual glands are not involved The electrical reactions will be normal The lesion may be traumatic, embolic or due to a new growth, and usually entails paralysis of the VIth nerve and hemiplegia The diagnosis of a lesion in this area is by the fact of the escape of the three muscles mentioned

Proceeding further along the course of the motor root, the next part of importance is the internal auditory meatus Occasionally the nerve is injured in the removal of an acoustic tumor Conversely, the sensory root which is closer to the VIIIth nerve than the motor root may be injured In the internal meatus that is up to the geniculate ganglion, injury is most commonly due to fracture of the base of the skull, and the VIth VIIth and VIIIth nerves are usually involved

The next important diagnostic site from the surgical point of view is from the geniculate ganglion to the stylomastoid foramen which is the Fallopian aqueduct. In the lower portion that is the vertical segment, which is between one-half and three-quarters of an inch long, the nerve runs through dense bone and it is in this portion only that Bell s palsy occurs In my opinion the chorda tympani nerve is the only important anatomical branching from the facial nerve that allows us to localize accurately the site of the lesion and this is done by testing for the sense of taste on the anterior two-thirds of the tongue Lesions of the nerve after it leaves the stylomastoid foramen are usually traumatic during operation or accident or due to new growth of the parotid gland and are easily distinguishable From an otological standpoint the facial nerve traverses three separate routes the labyrinthine, 1 mm , the tympanic, 8 mm , and the mastoid segment, 7 mm

The labyrinthine segment enters the bone through the internal auditory meatus from the posterior cranial fossa, running from within outward in the horizontal plane between the cochlea and the vestibule, ending in the geniculate ganglion The nerve in this location is not accessible to injury during a mastoid operation It then makes a right angled turn at the genu, commencing the tympanic segment, which enters the Fallopian canal on the internal wall of the middle ear just above and slightly anterior to the point where the ligament of the tensor tympani muscle is given off for its attachment to the handle of the malleus This ligament is a reliable guide to the position of the nerve during the radical operation The tympanic segment runs directly backward and slightly outward through the Fallopian canal in the horizontal plane until it passes between the horizontal semicircular canal and the oval window, then it makes another right angled turn, forming the mastoid segment, which runs directly downward in the vertical plane along the bottom of the posterior canal wall, leaving the temporal bone through the stylomastoid foramen at the mastoid tip In its horizontal course across the internal wall of the middle ear through the Fallopian canal the nerve is covered by an extremely thin layer of bone and is directly accessible to injury by the curette or undue pressure during the radical operation The average length of the facial canal in the adult is about 24 mm The bend between the mastoid and tympanic segments is termed the pyramidal segment and its average length is from 2 to 6 mm

The facial canal is a compact structure, varying in length and diameter Its average diameter in its mastoid segment is 4 mm , tympanic segment, 2 5 mm , at the stylomastoid foramen, 4 to 6 mm The contents of the canal, that is, the sheath, nerve and vascular supply, account for one-third or more of its transverse diameter It has been erroneously stated that in the upper portion these structures were more compactly placed than in the lower portion or at the stylomastoid foramen I cannot accept this statement, because according to our investigations the facial nerve just within and at its exit from the stylomastoid foramen is so compactly bound down and intimately surrounded by a dense periosteal sheath that it has less space to expand than if it were encased by the bony walls of the aqueduct, which canal it does not completely fill I consider this finding amply substantiated in the clinical manifestations of the commonly prevalent peripheral type of so-called Bell's palsy

Our observations have revealed in their order of importance that the following anatomical sites are the most commonly involved in surgical instrumentation in the temporal bone resulting in facial paralysis

1 The creation of an artificial antrum below and distal to the horizontal canal

2 Failure to identify the tympanic portion of the nerve proximal to the horizontal canal in the radical operation

3 Injury to the vertical segment of the nerve in an extensively pneumatized bone in removal of the retrofacial group of cells.

4 Injury to what is called the pyramidal segment of the nerve in the planing down of the hypotympanum on the posttympanic wall

5 The least common, either in infants or adults, injury to the nerve in the soft parts after its exit from the stylomastoid foramen excluding, of course, injuries and tumors.

In a previous writing, we stated that there are certain maxims that should be followed Time does not allow me to go into each one of these in detail, but I wish to speak about one.

That part of the nerve which occupies the canal between its tympanic and mastoid portions is the pyramidal segment I wish to emphasize this region, which I call the pyramidovertical or pyramidomastoidal segment. It is much more vulnerable not in the lowering of the posterior bony canal (or facial ridge) or knocking off the so-called facial spur, but on its inner aspect, the posterior tympanic wall region which must be subjected to thorough and accurate curettage in the removal of the annulus tympanicus and the requisite planing down of the hypotympanum, a fundamental step in the carefully executed complete operation This also is a danger area, in the fenestration operation in the removal of the bone, over and anterior to the posterior end of the horizontal canal, just below the chorda tympani nerve

It is advisable at the ouset in our consideration of the various methods of repair to state frankly that the recovery after the union of one nerve with another and even after direct suture of a divided nerve is never functionally perfect, although often amazingly satisfactory when compared with the preceding paralysis We should strive for two muscular actions the ability to close the eye and the ability to elevate the corner of the mouth Generally speaking, paralysis of all the muscles supplied by the facial nerve, combined with an inability of the nerve to conduct a faradic current applied through the skin, but with a response to galvanic stimulation of the musculature, is an indication of a lesion of the nerve fibres To determine which cases are suitable for operation and which are not, I rely not only upon the patient's reaction to serial faradic interpretations but also upon my experience gained over a period of years in the observations of these patients I particularly stress the importance of magnification in any procedure on the facial nerve I have been using it now for a period of 20 years Not only magnification but also a dissecting microscope giving 14 diopters of magnification, and it has been since the use of the latter that I was drawn to enunciate certain ideas, both in relation to nerve grafting, suturing and the plasma technique which previously had not been apparent under ordinary vision Along with Tickle and Cawthorne, the importance of the electrical reaction is stressed I have always made it a point to see for myself these reactions are carried out, particularly in the use of the faradic current It is often necessary to expose the nerve directly at the stylomastoid foramen, there will not then be any question that the electrode is placed directly on the nerve, eliminating the spread effect on adjacent muscles.

ELECTRICAL REACTIONS.

Muscle atrophy and the resulting fibrotic changes are soon apparent in the thin musculature of the face where there is no definite muscle fascia surrounding the individual muscles. These are inserted into subcutaneous tissue or skin without the intervention of any subcutaneous fascia When denervation has persisted for any length of time the fibrotic sheath which replaces the individual muscle cannot be made to contract even if continuity of the nerve could be restored The importance of physical treatment of the facial muscles in every patient with VIIth nerve palsy cannot be overestimated The best surgical technique which will restore conduction of the nerve impulse is useless if the facial muscles have been allowed to stretch and atrophy before the operation or while nerve regeneration is taking place.

FARADISM

A normal muscle responds to percutaneous faradic stimulation at low intensities If the nerve degenerates, its excitability decreases and is ultimately lost. It is taken for granted that we realize that faradism is a direct stimulation of short duration to nerves The muscle contracts because it is receiving impulses via the intramuscular nerve twigs Galvanism is a direct stimulation to muscle tissue The galvanic response is much more easily elicited Failure to elicit a galvanic response in muscle in the absence of edema indicates serious atrophic change in a muscle Fibrous tissue seems to wage a war of attrition upon muscle fibres

ELECTROMYOGRAPHY

From its history it is obvious that electromyography as it is known today is a direct application of electrophysiology to clinical medicine The action current of contracting muscles can be recorded The electrocardiogram is a well known ex ample By electromyography it is possible to record the action current in a voluntary muscle After section or severe compression of a nerve the muscle fibres supplied by it naturally lose their power of contracting on volition as well as the collective electrical disturbances associated with this It does not, however, spell the end of activity of the individual muscle fibres composing the motor units After a lapse of approximately three weeks these fibres may begin to enjoy an autonomous life, of which one manifestation is a rhythmic activity termed "fibrillation" As a result of muscle study, it is revealed that surgical repair, if necessary, should be undertaken as soon as possible In our experience the interpretation of electromyography results is strictly limited in facial palsy, and will show only a few active fibres, two to four weeks after the onset of the lesion, when damage already has been done

Weddell states that the most difficult muscles to relax are those of the face, tongue and abdomen The presence of fibrillation is considered of great diagnostic and prognostic significance in peripheral nerve injury, however, there are other symptoms in differentiating quantitatively between complete and partial denervation and qualitatively between paralysis due to transient nerve block and that due to axon degeneration At the moment, electromyography may well be possible in the future to standardize recording technique in terminology to such an extent as to make this practicable, but the time has not yet come, furthermore, the clinician, regardless of the findings by this method, can confirm or reject a tentative diagnosis either on clinical grounds or as a result of an exploration

In a case of inexcitability of a nerve below the level of the lesion it does seem probable that the retention of the faradic response is related to the presence of a few undegenerated nerve fibres

In some cases of facial paralysis it is difficult to obtain an accurate result by the faradic test, this is due to an unduly high skin resistance The faradic response may not be obtained in this case, yet when the nerve is exposed and an electrode applied directly to it, conductivity can be demonstrated For this reason the nerve should be exposed and stimulated in all questionable cases another finding that lends itself to this important prerequisite is the very fact that pain is a factor in faradic stimulation and as I have previously stated on many occasions this is why in order to be of a degree of finality, the test should be carried out under an anesthetic. Weddell states 'It is not possible by electromyography to distinguish between a total axonal interruption and a complete ischemic block for some days after the injury " Weddell's observations have not included many cases of traumatic facial paralysis or Bell s palsy where their findings for a great majority of these cases were quite unspecific He further states that ischemic block may persist in unlimited periods and in such a case recovery might be expected to follow decompression, unless a persisting infection is present There is experimental and clinical evidence that atrophy of muscles can be retarded by activity induced by adequate electrotherapy The contraction of the muscle is essential therefore, faradic stimulation of denervated muscle is useless and a waste of time Denervated muscle responds to galvanism and this is one method of treatment.

A detailed method of exposure of the nerve has been fully described by the author in a previous writing

NERVE GRAFTS

It is now an accepted principle in neurosurgery that a gap in an injured nerve can be bridged by means of a nerve graft A controversial point has arisen whether to use a fresh or degenerated graft Bently and Hill writing in the *British Journal of Surgery*, clearly describe an important piece of research work in this particular regard In conjunction with Dr Keith of the Department of Surgery at the Banting Institute of the University of Toronto we carried out investigations in nerve degeneration and regeneration in an attempt to demonstrate that the neurofibrils grew through the empty tubules Our experimental results proved that there was sat isfactory clinical evidence of regeneration through the graft, after removal and histological examination The clinical results in patients amply substantiate this finding This has been recorded in previous publications

BELL'S PALSY

The following is a summary of a paper read by the author before the American Otological Society, San Francisco, May, 1950 It is suggested that the reader refer to that paper for the details in full

The damaging effect of pressure on a nerve is due to occlusion of the blood vessel This dysregulation of the circulation, as I prefer to call it, affects primarily the myelin sheath and has little if any influence on the Schwann cells and axis cylinders Here is the temporary block to conduction, but continuous pressure produces other changes Vascular stasis occurs in neighboring segments, leading to edema above and below the site of compression, as we have shown Not only is the process of repair in the compressed area impeded, but a complete degenerative lesion involving the axis cylinders and Schwann cells is finally produced It is thus seen how reversible ischemic block, which may be present for lengthy periods in nerves of the limbs without leading to degeneration, will by persisting in the rigid facial canal produce increased vascular stasis and edema leading to complete degeneration Pain accompanying complete facial paralysis is indicative of a severe degenerative lesion

What is the fundamental neurosurgical principle involved in crushing injuries involving nerves and bones anywhere in the body but that of relieving the pressure on the involved nerve, thus mobilizing the nerve and allowing it to regain its functional condition as soon as possible If that is the principle involved in soft tissues, what must it be of a motor nerve encased in a bony canal? The extreme degree of edematous swelling which immediately prevails with marked swelling of the nerve bundles becoming manifest after the careful removal of the upper two-thirds of the bony canal without damage to the blood supply as far as it is surgically possible, and incising the epineural connective sheath along the side of the nerve instead of on its upper aspect in order to prevent damage to the longitudinal arterial anastomosis has been revealing to me over a period of 20 years in the examination of this nerve under a dissecting microscope. This appearance has been observed anywhere from three to 12 weeks, and particularly above the area of the actual foramen itself with less manifestation of this macroscopic change as the nerve extends outward and divides at the pes anserinus The rapidity of recovery following this procedure is only too self-evident.

The appearance of the nerve in cases anywhere from six months to a year following this change in which all that has remained has been a fibrous strand more than anything else vindicates the rationale of this procedure.

Merwarth states that recurrences of facial paralysis are fairly common, and particularly is this true in Bell's palsy It is, therefore, interesting to recall the fact that in all my cases subjected to surgical intervention no recurrence of facial paralysis has resulted on the operated side, similarly, that finding is true in the cases of Cawthorne, of England This means that compression, in addition to the dysregulation of the circulation, is the cause or the factor in the production of this lesion in the VIIth nerve.

We are dealing with a cranial nerve, a motor nerve, which has to do with muscular power and emotional expression, with facial muscles lacking a fascial covering and prone to rapid muscular atrophy If the triad of symptoms I have just enunciated is present, you cannot decompress the facial nerve too early

Some claim that vasospastic states can produce changes in nerves. This applies much more to a sensory nerve, such as the Vth nerve, than it does to a motor nerve, such as the facial nerve For example, in patients with severe Vth nerve neuralgia the administration of a vasodilator drug in some cases has helped There is also the possibility of involvement of the VIIIth cranial nerve and its end-organ in the typical condition of hydrops of the internal ear, but this is vasospasm within the Vth or the VIIIth nerve at the root of a sensory disturbance The argument which has been presented in the latter has been based upon examination and experience with sensory nerves I do not feel that this applies to the pure motor facial nerve

TO SUMMARIZE

1 Facial paralysis immediately following a mastoid operation, accompanied by loss of the faradic current, demands exploration

2 Where the nerve-ends can be placed in apposition within the Fallopian aqueduct, without tension, this is the procedure of choice

3 Where the intervening space as a result of the injury requires the interposition of a graft of less than 8 mm, a fresh graft may be used

4 Where the intervening space is 8 mm up to 30 mm, a degenerated graft is preferable for the reasons given

5 The rerouting of the nerve is not advised

6 The graft should be held in position by means of some retention substance, and for this procedure the use of the plasma technique is advocated

7 A Bell's palsy presenting complete facial paralysis, loss of the faradic response accompanied by pain, is indicative of a severe degenerative lesion and warrants immediate surgical interference

CORRELATION OF THE PREDICTED WITH THE ACTUAL RESULT OF FENESTRATION IN 164 CONSECUTIVE CASES [*][†]

GEORGE E SHAMBAUGH JR., M D ,
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Two uncertainties that confront the patient who is contemplating the fenestration operation are the immediate hearing result that he will attain and the permanence of this result.

In an attempt to diminish the first of these uncertainties, a simple, practical and dependable method was sought for predicting within a few decibels the level of hearing that might be anticipated from surgery in a particular patient In September 1950, a simple formula for predicting the probable result of fenestration was first described[1] This formula is based upon two propositions That the bone conduction audiogram when made with proper precautions and after certain corrections is a reliable and accurate measure of cochlear reserve that the successfully fenestrated ear has a certain residue of unrestored conductive loss due to the altered mechanics of sound conduction

THE BONE CONDUCTION AUDIOGRAM IN OTOSCLEROSIS

Many otologists distrust bone conduction audiometry, feeling that its results are sufficiently variable and unreliable to have little practical value. Carhart[2] has pointed out the reasons for this distrust and has suggested practical remedies for the practicing otolaryngologist These include proper calibration of the bone unit to give superimposed air and bone

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[*] Read at the meeting of the Middle Section, American Laryngological, Rhinological and Otological Society Inc., Indianapolis, Ind., Jan. 28 1952.

[†] From the Department of Otolaryngology Northwestern University Medical School

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curves in normal ears and in pure perceptive losses, correct audiometric technique in sufficiently quiet, sound treated testing rooms, and the use of proper masking

By a careful statistical analysis of test-retest results of air as compared with bone audiometry, Carhart and Hayes[3] demonstrated that *when appropriate precautions are observed the otolaryngologist may accept with equal confidence the precision of his bone conduction and air conduction audiometric measurements*

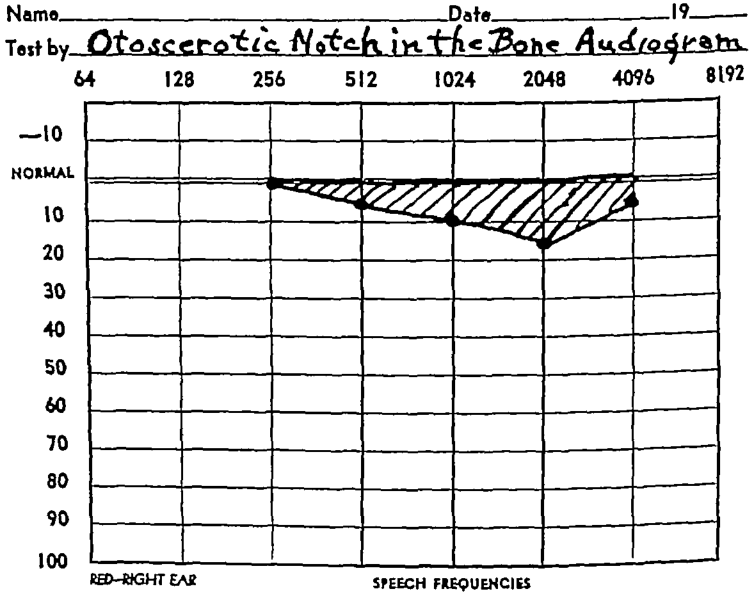


Fig 1 The average correction in the bone conduction audiogram of otosclerosis according to Carhart, required to determine the true cochlear reserve

Juers[4] was the first to call attention to a fairly consistent improvement in bone conducted hearing following fenestration, greatest for the 2,048 frequency Carhart[1] subsequently pointed out that stapes ankylosis produces a characteristic modification of the bone conduction audiogram consisting of a shallow notch that includes the frequencies of 512 through 4,096, deepest at 2,048 Since this notch largely disappears after fenestration and it is unreasonable to believe that fenestration reverses or removes cochlear nerve degeneration, Carhart suggests that it is a mechanical effect of stapes fixation To determine the true cochlear reserve of a case of clinical otosclerosis the bone conduction audiogram needs to be corrected for this mechanical notch. While the notch probably varies in depth in different ears, it averages about 5 db for 512, 10 db for 1,024, 15 db for 2 048, and 5 db for 4,096 (see Fig 1)

The bone curve corrected for the Carhart notch may be taken as the measure of the cochlear reserve

THE RESIDUE OF UNRESTORED CONDUCTIVE LOSS AFTER FENESTRATION

The normal ear possesses a lever-mechanism to overcome the difference in sound conduction in air as compared with water This mechanism consists of a large tympanic membrane, an ossicular chain and a small oval window to convert air vibrations of large amplitude and small force into water vibrations of small amplitude and large force. Deprived of this ' impedence-matching" lever mechanism, an ear loses between 20 and 30 db of hearing acuity, according to various estimates While the mechanics of the fenestrated ear are not well understood, it is clear that it does not possess an impedence matching lever mechanism, so that we should expect a residue of unrestored conductive loss after fenestration of between 20 and 30 db Davis and Walsh[6] found that a conductive deficit of 20 db was the *upper* limit of improvement in a group of operated cases without cochlear degeneration Tentatively, the author has selected 25 db as the *average* residue of unrestored conductive loss after a successful fenestration

FORMULA FOR PREDICTING THE RESULT OF FENESTRATION

To lessen errors inherent in audiometry three bone and air audiograms are made on different days preoperatively in quiet, inside sound treated testing rooms on instruments calibrated to give a zero reading for both air and bone on normal ears. The speech frequencies in the three bone audiograms

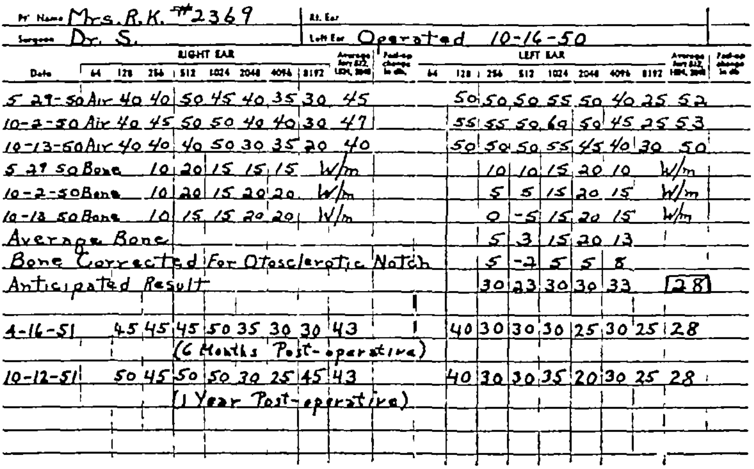
CASE	FENESTRATION AND SIDE		DATE	AVERAGE PRE-OP LEVEL FOR 512, 1024, 2048		ESTIMATE OF POST-OP RESULT	ACTUAL 6 MOS RESULT	DISCREPANCY BETWEEN ESTIMATE & ACTUAL	GAIN OR LOSS IN db AFTER FEN	UNOPER. EAR.
				AC	BC					
A	2747	L	10-16-50	52	13	28	28	0	+24	+1
A	2748	R	10-16-50	46	12	27	28	-1	+18	-1
A	2749	R	10-17-50	64	11	26	23	+3	+41	-3
A	2750	L	10-17-50	50	11	26	25	+1	+25	+4
A	2751	L	10-17-50	43	1	16	32	-16	+11	-5
A	2752	R	10-18-50	47	10	25	28	-3	+19	+6
B	2753	L	10-18-50	62	21	36	43	-7	+19	+1
A	2754	R	10-19-50	47	9	24	25	-1	+22	-6
B	2755	L	10-20-50	46	21	36	28	+8	+18	-3
A	2756	L	10-20-50	54	11	26	35	-9	+19	0
A	2757	L	10-23-50	47	8	23	17	+6	+30	+8
A	2758	L	10-23-50	55	7	22	27	-5	+28	-5
C	2759	L	10-24-50	79	27	42	42	0	+37	+2
A	2760	L	10-24-50	46	8	23	25	-2	+21	0
B	2761	L	10-24-50	53	13	28	25	+3	+28	+10
A	2762	R	10-25-50	55	5	20	38	-18	+17	-7
A	2764	R	10-25-50	43	12	27	37	-10	+6	-4
A	2765	R	10-26-50	55	9	24	40	-16	+15	+7
A	2766	R	10-26-50	40	0	15	25	-10	+15	-1
B	2767	L	10-27-50	64	14	29	30	-1	+34	+2
A	2769	R	10-27-50	60	9	24	32	-8	+28	+2
A	2770	L	10-31-50	46	13	28	27	+1	+19	+1
A	2771	R	11-2-50	49	12	27	22	+5	+27	+3
A	2772	L	11-6-50	48	13	28	28	0	+20	-2
A	2773	R	11-7-50	48	2	17	22	-5	+26	-5
A	2774	L	11-9-50	45	9	24	30	-6	+15	-1
B	2775	L	11-10-50	51	23	38	35	+3	+16	+6
A	2776	R	11-10-50	42	7	22	20	+2	+22	-1
A	2777	L	11-10-50	42	11	26	35	-9	+7	+1
B	2778	R	11-10-50	58	21	36	38	-2	+20	0
B	2779	R	11-11-50	52	22	37	37	0	+15	-1
A	2780	L	11-13-50	53	7	22	23	-1	+30	-9
A	2781	R	11-14-50	57	13	28	30	-2	+27	+3
A	2782	R	11-14-50	67	7	22	27	-5	+40	+5
A	2783	L	11-16-50	47	14	29	18	+11	+29	+6
B	2784	L	11-17-50	57	17	32	43	-11	+14	+2
C	2785	R	11-17-50	77	32	47	37	+10	+40	+3
B	2786	L	11-17-50	61	21	36	43	-7	+18	+3
A	2787	L	11-17-50	52	11	26	20	+6	+32	+3
A	2788	R	11-20-50	55	6	21	25	-4	+30	-3
A	2789	R	11-20-50	36	13	28	25	+3	+11	+6

CASE	FENESTRATION AND SIDE		DATE	AVERAGE PRE-OP LEVEL FOR 512, 1024 2048		ESTIMATE OF POST-OP RESULT	ACTUAL 6 MOS RESULT	DISCREPACNY BETWEEN ESTIMATE & ACTUAL	GAIN OR LOSS IN db AFTER FEN	UNOPER. EAR.
				AC	BC					
A	2790	L	11-20-50	49	13	28	32	-4	+17	+4
C	2791	R	11-7-50	70	30	45	42	+3	+28	+7
A	2792	R	11-24-50	48	8	23	22	+1	+26	+7
A	2793	L	11-27-50	54	15	30	33	+3	+21	-1
A	2794	R	11-27-50	52	11	26	28	-2	+24	-5
A	2795	L	11-27-50	54	8	23	40	-17	+14	-1
B	2796	R	11-28-50	68	19	34	58	-24	+10	+5
A	2797	R	11-28-50	50	10	25	27	-2	+23	-2
A	2798	R	11-30-50	43	10	25	33	-8	+10	-5
A	2799	L	12-1-50	54	11	26	22	+4	+32	0
B	2800	L	12-1-50	59	15	30	26	+4	+33	-4
A	2801	R	12-1-50	48	8	23	22	+1	+26	+1
C	2802	L	12-4-50	71	35	50	52	-2	+19	+1
A	2803	L	12-4-50	49	15	30	23	+7	+26	-2
B	2804	L	12-5-50	54	19	34	47	-13	+7	+2
A	2805	R	12-5-50	54	14	29	23	+6	+31	+5
B	2806	R	12-7-50	67	24	39	40	-1	+27	-1
A	2807	L	12-7-50	57	8	23	27	-4	+30	-3
A	2808	R	12-8-50	62	13	28	30	-2	+32	0
B	2809	L	12-11-50	55	17	32	28	+4	+27	0
B	2810	L	12-11-50	46	19	34	22	+12	+24	0
B	2811	L	12-11-50	57	17	32	28	+4	+29	-3
B	2812	R	12-12-50	74	22	37	40	-3	+34	0
A	2813	L	12-12-50	44	11	26	25	+1	+19	+7
A	2814	R	12-14-50	48	11	26	23	+3	+25	+3
A	2815	L	12-15-50	49	14	29	25	+4	+24	-1
B	2816	R	12-15-50	67	23	38	37	+1	+30	+1
B	2817	L	12-19-50	53	19	34	33	+1	+20	-3
A	2819	R	1-2-51	59	13	28	30	-2	+29	-3
A	2820	L	1-4-51	59	13	28	30	-2	+29	-4
A	2821	R	1-4-51	58	13	28	22	+6	+36	-4
A	2822	R	1-4-51	70	15	30	43	-13	+27	-6
A	2823	R	1-5-51	58	8	23	25	-2	+33	+5
A	2824	L	1-5-51	54	11	26	28	-2	+26	0
B	2825	R	1-8-51	57	4	39	38	+1	+19	-7
A	2826	L	1-8-51	44	15	30	25	+5	+19	+6
A	2827	L	1-9-51	46	7	22	18	+4	+28	-4
A	2828	R	1-11-51	49	10	25	23	+2	+26	+1
A	2829	R	1-15-51	48	12	27	27	+0	+21	-7
B	2830	R	1-16-51	57	23	38	75	-37	-18	+6
A	2831	L	1-19-51	53	8	23	28	-5	+25	-1
A	2833	L	1-23-51	52	14	29	28	+1	+24	-2

CASE	FENESTRATION AND SIDE		DATE	AVERAGE PRE-OP LEVEL FOR 512, 1024, 2048		ESTIMATE OF POST-OP RESULT	ACTUAL 6 MOS RESULT	DISCREPANCY BETWEEN ESTIMATE & ACTUAL	GAIN OR LOSS IN db AFTER FEN	UNOPER EAR
				AC	Bc					
B	2835	R	1-22-51	59	17	32	22	+10	+37	+6
B	2836	L	1-25-51	48	21	36	32	+4	+16	+2
A	2837	L	1-25-51	60	7	22	30	-8	+30	0
C	2838	R	1-25-51	83	29	44	95	-51	-12	-18
A	2839	R	1-26-51	58	14	29	37	-8	+21	-3
A	2840	R	1-26-51	56	13	28	35	-7	+21	-8
A	2841	R	1-29-51	57	13	28	35	-7	+22	-2
A	2842	L	1-29-51	47	14	29	25	+4	+22	-8
A	2843	R	1-30-51	47	14	29	18	+11	+29	+2
C	2844	L	1-30-51	74	35	50	62	-12	+12	+8
A	2845	L	2-1-51	53	10	25	28	-3	+25	-1
C	2846	R	2-1-51	85	33	48	63	-15	+22	-3
A	2847	L	2-3-51	68	16	31	25	+6	+43	-1
A	2848	R	2-5-51	59	14	29	37	-8	+22	+5
A	2849	R	2-5-51	36	11	26	20	+6	+16	+12
A	2851	L	2-8-51	63	10	25	23	+2	+40	+6
A	2852	R	2-9-51	44	8	23	20	+3	+24	-6
A	2853	R	2-12-51	55	10	25	30	-5	+25	-1
B	2854	L	2-15-51	73	20	35	28	+7	+45	+5
A	2855	L	2-16-51	45	15	30	30	+0	+15	+1
B	2857	L	2-19-51	62	19	34	38	-4	+24	-3
B	2859	R	2-22-51	56	23	38	25	+13	+31	+0
C	2860	R	2-23-51	89	42	57	52	+5	+37	+7
A	2861	R	2-23-51	58	5	20	28	-8	+30	-1
A	2862	R	2-26-51	57	14	29	22	+7	+35	+1
A	2863	R	2-26-51	49	11	26	28	-2	+21	-1
A	2865	L	2-27-51	46	12	27	22	+5	+24	+3
A	2866	L	2-27-51	64	15	30	40	-10	+24	+3
A	2869	L	3-5-51	49	13	28	35	-7	+14	-2
A	2870	L	3-5-51	47	13	28	27	+1	+20	-1
B	2871	L	3-5-51	53	24	39	38	+1	+15	+4
B	2872	R	3-6-51	63	22	37	32	+5	+31	+5
B	2873	R	3-8-51	73	23	38	37	+1	+36	+5
A	2875	L	3-16-51	36	10	25	23	+2	+13	+6
B	2876	R	3-19-51	82	19	34	50	-16	+32	+4
B	2877	R	3-19-51	56	21	36	33	+3	+23	+2
B	2878	R	3-20-51	68	14	29	42	-13	+26	+0
A	2879	L	3-22-51	49	7	22	30	-8	+19	-1
A	2881	L	3-26-51	67	14	29	25	+4	+42	+5
A	2883	R	3-27-51	65	17	32	33	-1	+32	+2
A	2884	R	3-27-51	49	12	27	28	-1	+21	-2
C	2887	R	3-30-51	65	27	42	45	-3	+20	-4

CASE	FENESTRATION AND SIDE		DATE	AVERAGE PRE-OP LEVEL FOR 512 1024, 2048		ESTIMATE OF POST-OP RESULT	ACTUAL 6 MOS RESULT	DISCREPANCY BETWEEN ESTIMATE & ACTUAL	GAIN OR LOSS IN db AFTER FEN.	UNOPER. EAR.
				AC	BC					
C	2888	L	4-2-51	64	27	42	40	+2	+24	+3
A	2891	L	4-5-51	57	9	24	22	+2	+35	+7
A	2894	R	4-6-51	55	17	32	30	+2	+25	+3
B	2896	R	4-9-51	72	24	39	57	-18	+15	+3
A	2897	R	4-10-51	49	14	29	15	+14	+34	-3
B	2898	R	4-12-51	48	17	32	25	+7	+23	+0
A	2899	R	4-16-51	48	15	30	23	+7	+25	+4
B	2900	R	4-16-51	62	18	33	32	+1	+30	+2
A	2901	R	4-17-51	44	3	18	22	-4	+22	+6
A	2902	R	4-19-51	53	14	29	27	+2	+26	+1
A	2904	R	4-20-51	45	15	30	30	+0	+15	+7
A	2905	R	4-23-51	54	13	28	50	-22	+4	-3
A	2908	R	4-26-51	53	13	28	27	+1	+26	+2
B	2909	R	4-27-51	69	19	34	30	+4	+39	+9
C	2911	R	5-1-51	72	15	30	72	-42	+0	-2
A	2913	R	5-7-51	47	13	28	28	+0	+19	-2
A	2915	L	5-14-51	48	16	31	27	+4	+21	+1
A	2917	R	5-14-51	53	6	21	33	-12	+20	+0
B	2922	L	5-18-51	72	21	36	37	-1	+34	+4
A	2923	L	5-21-51	55	12	27	23	+4	+32	-2
A	2927	R	5-22-51	45	10	25	28	-3	+17	-3
B	2931	R	5-28-51	53	24	39	52	-13	+1	-2
A	2935	R	6-5-51	45	9	24	17	+7	+28	+7
B	2936	L	6-7-51	67	12	27	28	-1	+39	+5
A	2937	R	6-8-51	48	3	18	17	+1	+31	-1
C	2938	L	6-11-51	87	41	56	77	-21	+10	+7
C	2939	R	6-12-51	60	25	40	40	+0	+20	+2
A	2940	R	6-14-51	71	9	24	20	+4	+51	+9
B	2946	R	6-21-51	55	13	28	27	+1	+28	+7
A	2948	R	6-22-51	39	9	24	15	+9	+24	+5
B	2951	R	6-25-51	59	18	33	32	+1	+27	+2
A	2952	L	6-25-51	64	13	28	22	+6	+42	+5
A	2953	R	6-25-51	54	11	26	18	+8	+36	+3
A	2962	R	7-2-51	43	3	18	20	-2	+23	-3
A	2963	R	7-2-51	50	7	22	23	-1	+27	+4
A	2968	R	7-10-51	46	2	17	23	-6	+23	+5
B	2969	L	7-12-51	55	17	32	37	-5	+18	+2
B	2976	L	7-17-51	55	30	45	53	-8	+2	+5
A	2978	L	7-19-51	54	12	27	27	+0	+27	+3

are averaged and corrected for the Carhart notch (see Fig 2) The predicted result of fenestration is a hearing level 25 db below the corrected bone curve Since the correction for the notch averages 10 db for the speech frequencies, one may simply predict the result of fenestration in a particular patient as a hearing level 15 db below the average audiometric bone readings for 512, 1,024 and 2,048



Pt Name Mrs. R.K. #2369
Surgeon Dr. S.
Rt. Ear
Left Ear Operated 10-16-50

	RIGHT EAR										LEFT EAR									
Date	64	128	256	512	1024	2048	4096	8192	Average Air 512, 1024, 2048	Post-op change in db	64	128	256	512	1024	2048	4096	8192	Average Air 512, 1024, 2048	Post-op change in db
5 29-50 Air		40	40	50	45	40	35	30	45			50	50	50	55	50	40	25	52	
10-2-50 Air		40	45	50	50	40	40	30	47			55	55	50	60	50	45	25	53	
10-13-50 Air		40	40	40	50	30	35	20	40			50	50	50	55	45	40	30	50	
5 29 50 Bone			10	20	15	15	15	W/m					10	10	15	20	10	W/m		
10-2-50 Bone			10	20	15	20	20	W/m					5	5	15	20	15	W/m		
10-13 50 Bone			10	15	15	20	20	W/m					0	-5	15	20	15	W/m		
Average Bone													5	3	15	20	13			
Bone Corrected For Otosclerotic Notch													5	-2	5	5	8			
Anticipated Result													30	23	30	30	33		28	
4-16-51		45	45	45	50	35	30	30	43			40	30	30	30	25	30	25	28	
(6 Months Post-operative)																				
10-12-51		50	45	50	50	30	25	45	43			40	30	30	35	20	30	25	28	
(1 Year Post-operative)																				

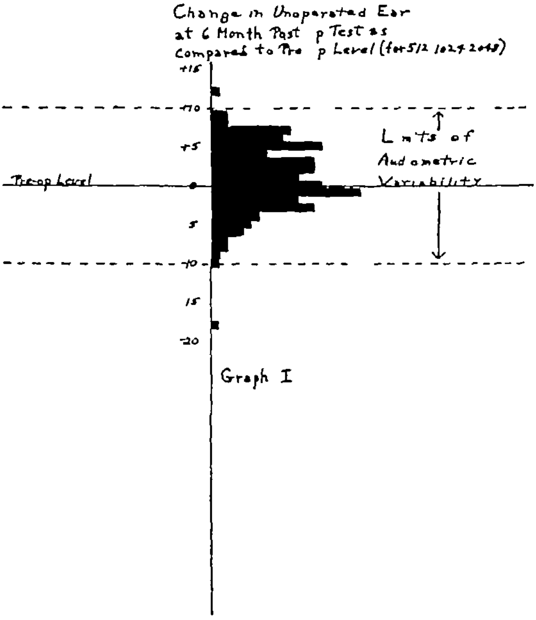
Fig 2 Calculation of anticipated result of fenestration The average bone loss for 512 1 024 and 2 048 in three preoperative audiograms is corrected for the otosclerotic notch The anticipated result is 25 db below the corrected bone curve In this patient the actual result six months after operation was the same as the anticipated result.

STATISTICAL STUDY OF THE PREDICTED AND ACTUAL RESULT IN 164 CASES

The simple formula for predicting the result of fenestration has been applied preoperatively to all cases operated at Northwestern University during the last 15 months

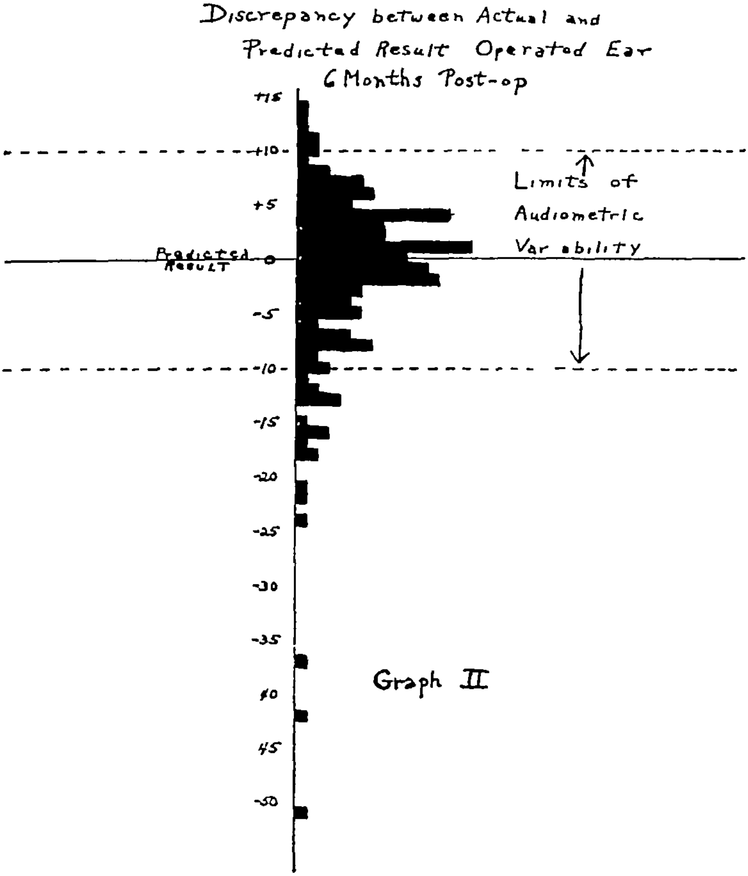
To test the correctness and validity of the formula, the actual result six months after fenestration when the hearing has become fairly well stabilized was compared with the predicted result A total of 164 cases was available for study, these cases being consecutive except for a few where we did not have an audiogram at approximately six months after operation

There were 108 "A" cases of ideal suitability because of bone conducted hearing within the normal range for the speech frequencies of 512, 1,024 and 2 048 There were 43 "B' cases of good but not perfect suitability because of early cochlear involvement with bone conducted hearing below normal for 2,048 There were 13 'C" cases of borderline suitability because of moderate cochlear involvement with bone conducted hearing below normal for two or three of the speech frequencies.



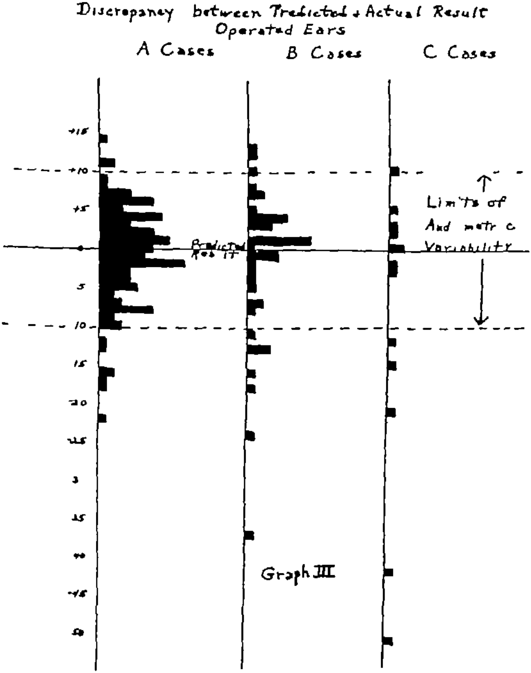
Graph I

The significant audiometric data on each case is summarized with the classification ("A' 'B" or "C') in the first column, the second column is the patient's number in the Northwestern fenestration series, third is the side operated, fourth is the date of operation, fifth is the average preoperative loss for the speech frequencies by air conduction, sixth is the average loss before operation by bone conduction, seventh

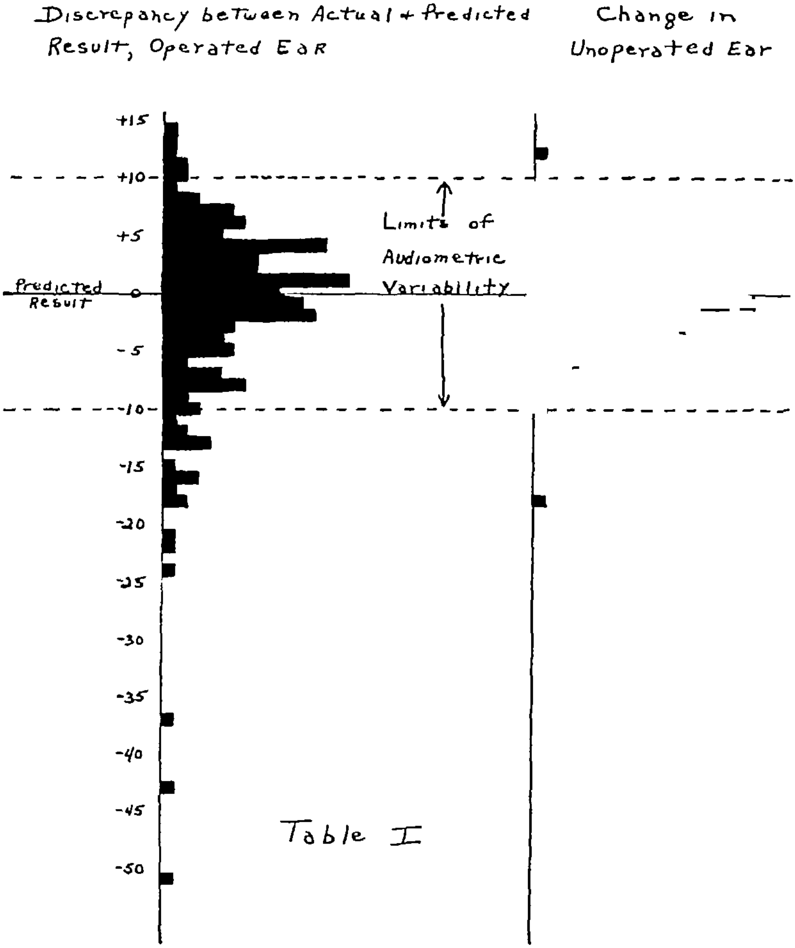


is the predicted result (15 db below the average bone loss), eighth is the actual result at six-month test, ninth is the discrepancy between the predicted and the actual result, tenth is the gain or loss in the operated ear, and the eleventh and last column is the gain or loss in the unoperated ear

The first graph shows the hearing in the *unoperated* ear six months after operation as compared with the preoperative level Each square horizontally represents 1 db Observe how the cases are bunched within several decibels of the preopera-



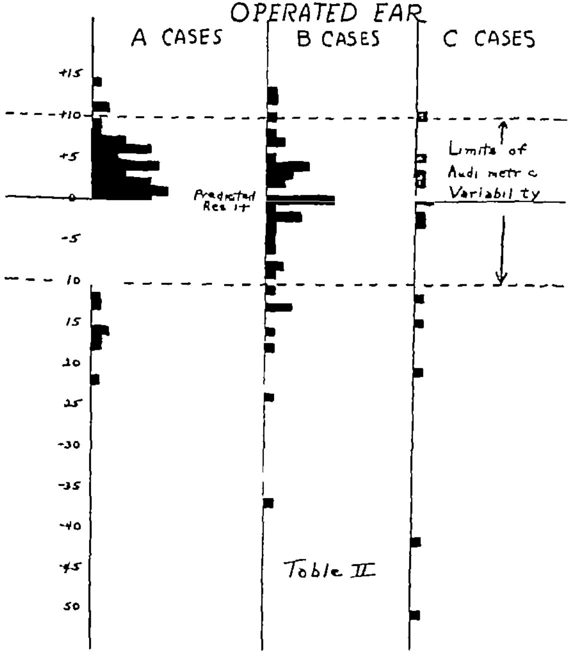
tive hearing (0 '), being distributed fairly equally on both sides This confirms the observation previously made that *fenestration does not change the hearing in the unoperated ear* Observe also that with three exceptions the hearing in the unoperated ear was within 10 db of the preoperative level, suggesting that 10 db may be taken as the average limits of variability in either direction of the hearing level of a patient with otosclerosis


Discrepancy between Actual + Predicted Result, Operated Ear

Change in Unoperated Ear

Table I

On the second graph the actual six months result is compared with the predicted result of fenestration Observe how closely the bunching of results resembles the bunching seen in the graph of the unoperated ear, but with two notable exceptions First, we see that there is a little wider spread on either side of the 10 db limit of audiometric variability This might be due to variations in the depth of the otosclerotic notch of Carhart, not taken into account by the average correction Thus a shallow notch would be overcorrected, and the predicted result would be too high, and a deep notch would



be undercorrected so that the predicted result would be too low Second we see that there is a sprinkling of cases totalling 12, where the actual result falls short of the predicted result by more than 15 db These can be regarded as failures if we assume that the formula is correct, even though some of them may show a significant gain in hearing For example, Patient 2896 gained 15 db of hearing for the speech frequencies but fell 18 db short of the predicted gain

In the third graph the predicted and actual results are broken down according to preoperative classification It is interesting to observe that the incidence of failures is significantly greater in the cases of "B" and "C" suitability than in the ideal cases

From this study it appears that the result of a fenestration operation in a particular patient may be predicted with a fair degree of accuracy by means of a simple formula, with allowance for the variability of repeated audiograms in a patient with otosclerosis and for possible variations in the depth of the otosclerotic notch in the bone conduction audiogram

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CARCINOMA OF THE LARYNX

A Report of 194 Cases with 149 Laryngectomies [*]

JULIUS W McCALL, M D
and
WILLIAM R FISHER, M D ,
Cleveland, Ohio

This is a review of the results obtained at St Luke's Hospital in 194 cases of cancer of the larynx from 1936 through 1950

TABLE 1

Total number of cases	194
No treatment or irradiation alone	27
Arbuckle	9
Laryngofissure	14
Laryngectomy	149
Radical neck dissection	18

Of this group 27 had irradiation alone or refused treatment altogether There were nine Arbuckle procedures Fourteen laryngofissures were done five of which were followed by laryngectomy There were 149 laryngectomies and 18 radical neck dissections either at the time of or following laryngectomy

TABLE 2
SEX.

Total	195	
Male	187	96%
Female	8	4%

Read at the meeting of the Southern Section, American Laryngological Rhinological and Otological Society Inc., Atlanta, Ga. Jan. 13 19 2.

Editor's Note This ms. received in Laryngoscope Office and accepted for publication Feb. 7 195.

There was a marked white male predominance, 186 being in this group, seven white females and one each colored, male and female

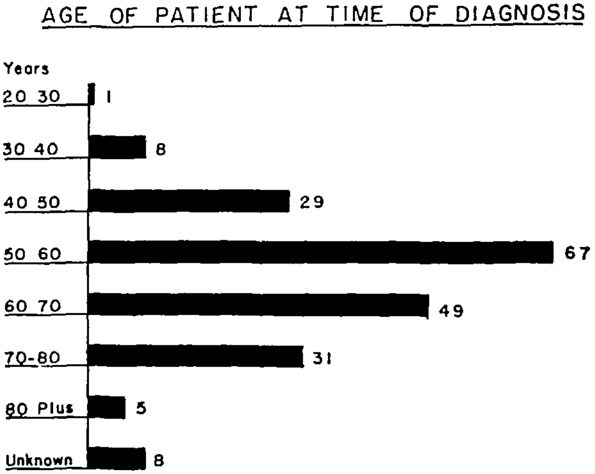
AGE OF PATIENT AT TIME OF DIAGNOSIS

Fig 1

The age at time of diagnosis ranged from the third to the ninth decade with a predilection for the 50 to 70 age group The youngest was a woman of 24, who was six months' pregnant Following laryngectomy she went on to term, had a normal child and has since had another

TABLE 3
HOARSENESS AS A SYMPTOM

	Int.	Ext.	Total
Alone	33%	24%	57%
With other S S	7%	22%	29%
Total	40%	46%	86%

Hoarseness was the predominant symptom, occurring as the only symptom in 57 per cent of all cases and in company with others in 29 per cent Of all patients with a five-year survival without recurrence, hoarseness was the only symptom in 70 per cent (23 out of 33)

TABLE 4
SYMPTOMS AND THEIR INCIDENCE

	Int.	Ext.	Total	%
Hoarseness	71	82	153	86
Pain	4	29	33	19
—alone	1	4	—	—
Hemoptysis	—	9	9	5
—alone	—	1	—	—
Dysphagia	2	25	27	15
Cough	6	13	19	11
Dyspnea	5	13	18	10
Palpable mass noted by the patient	—	13	13	7
Weight loss noted by the patient	2	10	12	7

Pain was the next most common occurring in 19 per cent, dysphagia occurred in 15 per cent. It should be our duty to advise our colleagues, friends, patients and the general public that hoarseness is a serious problem and should be investigated

TABLE 5
LARYNGOFISSURES

Total	11	
Laryngectomy afterwards	3	
Free of disease		
Less than 1 year		2
1 2 years		1
2-3 years		1
4-5 years		2
7 years		1
		7

There were 14 laryngofissures in this series three of which were done elsewhere and followed here One of these died of recurrence in less than two years, and two had laryngectomy for recurrence one year and 12 years later There is no follow up on one additional patient. Of the remaining 10 cases done here one had laryngectomy because of incomplete resection on microscopic inspection, and two required laryngectomy for recurrence two and six years after fissure The remaining seven patients are free of disease four months to seven years

There was a marked white male predominance, 186 being in this group, seven white females and one each colored, male and female

AGE OF PATIENT AT TIME OF DIAGNOSIS

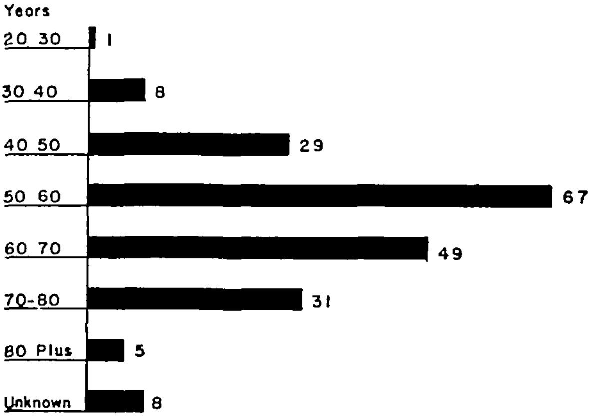

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TABLE 6
ARBUCKLE PROCEDURE

Total	9
Dead of cancer	6
Dead no evidence of cancer	1
Alive without recurrence	2

The Arbuckle procedure was performed on nine patients by some of the younger men to appraise its worth In fairness we will state that eight of these cases were far advanced Five of these patients were dead in less than six months, one due to pneumonia and crusts blocking the tracheal stoma, no evidence of carcinoma being found at autopsy The other four died of carcinoma Two additional patients died of cancer in less than a year and one-half Two patients are living and apparently free of disease three years after treatment Following the procedure there was one esophagotracheal fistula, one esophageal stenosis, and one chronic, crusting tracheitis

There were 149 laryngectomies, 86 of which were done five or more years ago All were done under general endotracheal anesthesia with instillation of 4 per cent cocaine into the trachea and infiltration of the skin and the immediate operative field with novocaine 1 per cent containing 5 to 15 minums of epinephrine per ounce, depending upon the patient's preoperative blood pressure and cardiac status From 1936 through 1941, avertin was used for basal anesthesia, from 1942 through 1950, pentothal, alone or in combination with nitrous oxide, was used as the anesthetic of choice A high concentration of oxygen was applied to the endotracheal tube throughout the operation except during the actual work on the tracheal stoma After 1947, novocaine block of the cervical plexus was performed by the anesthesia department before the start of the operation in nearly all cases

The 86 patients laryngectomized from 1936 through 1946 are divided into intrinsic and extrinsic. For this report, the intrinsic are defined as involving one or more of the structures between and including the true and the false vocal cords, from the thyroid cartilage anteriorly to the arytenoids posteriorly but not invading either All others are extrinsic including spread to any of the cartilages, epiglottis, neck, pharynx, esophagus, or subglottically to the trachea There were 50 extrinsic and 36 intrinsic. There were a further 19 cases excluded from the analysis because of death during the initial hospital stay (four, all extrinsic), death after discharge not due to the operation or the cancer (two intrinsic four extrinsic), and the inability to follow the patient for five years (six intrinsic eight extrinsic)

TABLE 7
INTRINSIC TREATED BY LARYNGECTOMY
1936-1946 Inclusive.

Total	28	
Death due to cancer	3	
Five-year survival without recurrence	25	90%

Of the remaining 28 intrinsic one patient died of recurrence in less than six months one died of recurrence more than 10 years later and two died of recurrence but the date is unknown one lived more than five years without disease but had developed recurrences when last seen Twenty three have lived more than five years without disease and counting the two above who developed recurrences more than five years

TABLE 8
INTRINSIC TREATED BY LARYNGECTOMY
1936 1941 Inclusive

Total	7	
Deaths due to cancer	2	
Ten year survival Without recurrence	5	71%

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The 86 patients laryngectomized from 1936 through 1946 are divided into intrinsic and extrinsic For this report, the intrinsic are defined as involving one or more of the structures between and including the true and the false vocal cords from the thyroid cartilage anteriorly to the arytenoids posteriorly but not invading either All others are extrinsic including spread to any of the cartilages epiglottis, neck, pharynx, esophagus or subglottically to the trachea There were 50 extrinsic and 36 intrinsic. There were a further 19 cases excluded from the analysis because of death during the initial hospital stay (four, all extrinsic), death after discharge not due to the operation or the cancer (two intrinsic, four extrinsic), and the inability to follow the patient for five years (six intrinsic eight extrinsic)

TABLE 7
INTRINSIC TREATED BY LARYNGECTOMY
1936-1946 Inclusive

Total	28	
Death due to cancer	3	
Five-year survival without recurrence	25	90%

Of the remaining 28 intrinsic, one patient died of recurrence in less than six months one died of recurrence more than 10 years later and two died of recurrence but the date is unknown, one lived more than five years without disease but had developed recurrences when last seen Twenty three have lived more than five years without disease and counting the two above who developed recurrences more than five years

TABLE 8
INTRINSIC TREATED BY LARYNGECTOMY
1936-1941 Inclusive.

Total	7	
Deaths due to cancer	2	
Ten year survival Without recurrence	5	71%

after surgery, the five-year survival without recurrence for intrinsic carcinoma of the larynx treated by laryngectomy is 90 per cent in this series

There are nine cases among the intrinsics which were done more than 10 years ago Two were last seen between five and 10 years after surgery and had no evidence of cancer at that time Three died of recurrence, one in less than a year, one in his fifteenth year, and the date is unknown for the other Four of the seven followed more than 10 years are still living and are free of disease, one, 15 years later, one, 13, and two, 10 years later

TABLE 9
EXTRINSIC TREATED BY LARYNGECTOMY
1936 1946 Inclusive

Total		34	
Deaths due to cancer inless than five years		24	
Alive with recurrence in less than five years		3	
Five-year survival Without recurrence		7	21%
Total incompletely resected		17	
Death unrelated		1	
No follow up		1	
Death due to recurrence			
Less than two years	11		
2 3 years	1		
Date unknown	2		
	—	14	
Alive with recurrence in less than two years		1	
Five-year survival for extrinsic completely resected			37%

For the remaining 34 extrinsic cases with a five-year follow-up the results are much more depressing Twenty-six patients died of carcinoma, only two of whom survived more than five years Three patients had metastases when last seen less than four years after laryngectomy Only five patients were alive without recurrence when last seen more than five years later Counting the two who developed recurrences after five years, the five-year survival without recurrence in extrinsic carcinoma treated by laryngectomy is only 21 per cent in this series

In 17 cases carcinoma was left at the time of surgery, either it was visible grossly but could not be removed, or on microscopic examination the tumor was found to extend to the line of resection. Adjusting the values for extrinsic carcinoma to include only those in which all the cancer was apparently removed at surgery, the five-year survival rate for extrinsic carcinoma is still only 37 per cent There is one 15-year survival among these

TABLE 10
CARCINOMA TREATED BY LARYNGECTOMY
1947 1950 Inclusive.

Total	63
Dead of unrelated causes	2
Dead of carcinoma	12
Living with recurrence	4
Living without recurrence	45

From 1946 through 1950 there were 63 laryngectomies done here. Twelve patients are dead of recurrences, four are living with recurrences and two are dead of unrelated causes The others were living without obvious cancer when last seen

TABLE 11.

Cases diagnosed 1936-1946	
Intrinsic	41%
Extrinsic	59%
1947 1950	
Intrinsic	50%
Extrinsic	50%

From 1936 through 1946 there were 41 cases of intrinsic and 59 cases of extrinsic carcinoma diagnosed at this hospital. From 1947 through 1950, there were 42 cases of intrinsic and 42 cases of extrinsic carcinoma This indicates that physicians and the general public are recognizing the seriousness of hoarseness and are investigating it earlier

TABLE 12
RADICAL NECK DISSECTIONS

Total done on 16 patients		18
Dead of recurrence 2 years later		8
Living with recurrence 2 years later		2
Death in hospital		1
Alive without recurrence		5
Less than 1 year	2	
1 2 years	1	
3 4 years	2	

Eighteen radical neck dissections were done on 16 patients Ten were done at the time of laryngectomy and eight were done for recurrences up to a year and one-half later Eight were dead less than two years after the dissection, two were living with recurrences in less than two years, one died in the hospital during the initial stay, and five are living without recurrences, two less than a year, one 27 months, and two are in their fourth year It is felt that these were done too seldom and too late Neck dissection should be done for all cases of extrinsic carcinoma at the time of laryngectomy even in the absence of palpable nodes

The combined five-year survival rate without recurrence for laryngectomized patients in this series is 52 per cent, or, excluding those 17 in whom the tumor was incompletely resected, the rate rises to 73 per cent Jackson,[1] in 1945, reported a five-year survival of 75 per cent in intrinsic carcinomas treated by fissure or laryngectomy, and a 64 per cent five-year cure rate for all types of treatment, whether intrinsic or extrinsic In 1948, Schall[2] reported a 64 per cent survival for laryngectomized patients Clerf,[3] also in 1948, reported a 64 per cent overall survival, and survival without recurrences in five years of 58 7 per cent Martin[4] has reported 31 per cent five-year cures in intrinsic and 10 per cent in extrinsic Many of the patients in this series were admittedly poor risks both as to general conditions of age, heart, hypertension, etc, and as to the possibility of cure of the cancer, but it was felt they should be given the chance of one or two years of extra life they would otherwise not have had

TABLE 13

QUALITY OF ESOPHAGEAL VOICE.

With	Preop Train	Without
67 or 68%	Good	13 or 48%
16, or 16%	Poor	1 or 4%
16 or 16%	None	13 or 48%

Preoperative training in belching, even for a day is one of the most important factors in the development of an esophageal voice.[5] The ability to be understood over the telephone is taken as the gauge of a good esophageal voice One which cannot be so understood but which is understandable directly is a poor voice. Of 99 patients receiving some form of preoperative training in belching, 68 per cent developed a good voice as opposed to 48 per cent who received no such training Sixteen per cent receiving training developed poor voices and the same per cent had no voice, as compared to 4 and 48 per cent for the 27 receiving no training

TABLE 14

ADDITIONAL PRIMARY MALIGNANCIES

Carcinoma of the esophagus	2
Leucemia	1
Malignant follicular lymphoma	1

Additional primary malignancies developed in four patients in addition to the carcinoma of the larynx One had a malignant lymphoma of the larynx and the cervical nodes at the time of laryngectomy, one developed leucemia, and two developed primary carcinoma of the esophagus

One of the latter was inoperable when diagnosed seven years after laryngectomy the other had an esophagectomy and still maintained an understandable voice. An additional patient developed a solitary pulmonary metastasis underwent pneumonectomy four years after laryngectomy and is again free of disease one year later Two laryngectomized patients drowned when their fishing boats overturned, water sports are an added hazard in these cases and the patient should be so informed

SUMMARY

1 One hundred ninety-four cases of cancer of the larynx are reported

2 Hoarseness was the only symptom in 70 per cent of the five-year survivals

3 There were 14 laryngofissures Five had laryngectomy later One died of recurrence Seven are living without recurrence at the present time

4 Of nine Arbuckle procedures, only two patients are living and free of disease two to three years later

5 One hundred forty-nine laryngectomies were done under general anesthesia with no immediate postoperative deaths There were eight deaths during the initial hospital stay

6 Of the intrinsic carcinomas treated by laryngectomy and followed for five or more years, 90 per cent survived more than five years without evidence of disease Of seven patients with a 10-year follow-up, four are living without cancer

7 In extrinsic carcinomas, the five-year survival rate was only 21 per cent

8 The overall five-year survival rate for laryngectomized patients was 52 per cent

9 Carcinoma of the larynx is being seen earlier at this hospital

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We thank Dr F W Alexander, Dr L. C Dickey Dr F S Gardiner Dr A J Lamb, Dr P M Moore and Dr H. C Rosenberger for their help in obtaining follow up data on their patients included in this series and Mr Fred Beale for his help in preparing the tables used in this presentation

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SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

The joint meeting of the North Carolina Eye, Ear, Nose and Throat Society and the South Carolina Society of Ophthalmology and Otolaryngology will be held in Winston-Salem, N C, Sept. 15-17 Headquarters Robert E Lee Hotel in Winston-Salem with the following guest ophthalmologists Dr P Robb McDonald, Philadelphia, Pa., Dr Irving H Leopold Philadelphia Pa. Dr Harold W Brown, New York, N Y, and Dr Frank W Newell Chicago Ill

The guest otolaryngologists include Dr Theodore E Walsh, St Louis, Mo Dr Frank Tourschik, Bridgeport, Conn and a third otolaryngologist to be announced later

For further information please communicate with Dr C B Ferguson, Secretary of the North Carolina Eye Ear Nose and Throat Society c/o The McPherson Hospital, 1110 West Main Street, Durham N C, or with Dr Roderick Macdonald Secretary of the South Carolina Society of Ophthalmology and Otolaryngology 330 East Main Street Rock Hill, S C

AN AFFERENT REPRESENTATION OF THE LARYNX IN THE CEREBELLUM

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INTRODUCTION

It is obvious to those concerned with laryngeal disease that important central connections must exist in relation to the afferent nerve supply of the larynx Laryngeal functions in both health and disease, particularly cough and reflex closure of the vocal cords, autonomic (neuromuscular, neurovascular and neurosecretory) reflex activity, appreciation of specific sensations, maintenance of cord tonus, and the delicate control of phonation—these complex functions presuppose a diverse system of neuronal centers and pathways in the cerebrospinal axis In all probability, reflex arcs predominate at the brainstem and cerebellar levels, while conscious apperception of various modalities rest in the thalamus and cerebral cortex, yet, neuroanatomical or electrophysiological evidence for these tracts is practically unknown and, therefore, the present investigation was carried out to demonstrate the rôle that hindbrain structures may play in the synaptic mediation of impulses derived from laryngeal receptors

The superior laryngeal nerve, well accepted as the principal sensory supply of the larynx, was selected for afferent stimulation To study medullary and cerebellary projection areas, specific electrical responses were recorded after the proximal segment of the cut superior laryngeal nerve of the cat was stimulated by single shocks Consistent potentials were found

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in two discrete areas of the cerebellar cortex crus I of the ansiform lobule bilaterally, and the third and fourth folia of the paramedian lobule bilaterally (see Fig 1)

METHOD

Twelve cats weighing 2 0 to 2 5 kg were given 30 mgm /kg body weight of veterinary nembutal intraperiotoneally A stable level of anesthesia of moderate depth was maintained by the addition of endotracheal ether through a low tracheotomy Extension of the longitudinal incision from the mandible to the supraclavicular notch afforded excellent exposure of the cervical vagus, nodose ganglion, and superior laryngeal nerve After immobilization in a head holder, each animal was rotated 75 degrees along its longitudinal axis in a specially devised rack. In this position both the cerebellum and the superior laryngeal nerve could be approached with ease

The superior laryngeal nerve was dissected free throughout its entire course from the nodose ganglion to the thyrohyoid membrane. The external or motor branch to the cricothyroid muscle was identified and separated from the larger sensory branch before the latter was severed The proximal segment of that nerve was then placed upon No 24 nichrome wire electrodes, completely insulated except for actual stimulating surfaces in contact with the nerve The entire nerve preparation was carefully suspended in air away from other body tissues and protected from drying by mineral oil

After exposure of the dorsal surface of the cerebellum, a specially-devised microscope mechanical stage mounted upon the headholder permitted exploration of the brain stem and cerebellum in all principal planes Silver recording electrodes were insulated except for a 100 μ tip A critical exploring electrode was led against a periosteal electrode situated remotely to the cerebellum Spontaneous and cerebellar response potentials were recorded on a cathode ray oscilloscope Single shocks of varying duration and intensity were delivered to the superior laryngeal nerve through an isolation transformer The thresholds necessary to activate the different types of fibres in the nerve were determined and then compared with those sufficient to evoke the specific cerebellar or brain-stem response Arbitrarily, threshold stimuli will be referred to by the unit 1, and supraliminal strengths as multiples of 1

All exposed areas of the dorsal cerebellum were explored, the critical electrode tip just touching the pial surface of the exposed cortex The vermis, lobulus simplex, crus I and II of lobulus ansiformis, and lobulus paramedianus were accessible to examination The ventral surfaces were not studied The medulla was similarly explored in six experiments, the results of which will be reported after more thorough investigation

RESULTS

In these experiments, the superior laryngeal nerve of the cat demonstrated two potential components *1* a large initial spike potential with conduction rate of 25-30 M/sec, derived from 6-10 μ (cross-sectional diameter) fibres showing a relatively low threshold, designated as 1, *2* a considerably smaller wave with rate of about 3 M/sec related to thinly myelinated fibres of 2-4 μ size propagated by stimulus intensity 75 Osmic acid impregnation revealed that the larger fibres accounted for three-fourths of the cross-sectional area of the superior laryngeal nerve

Corresponding to the activation of the larger myelinated, most rapidly conducting fibres of the superior laryngeal nerve, responses were recorded from remarkably discrete areas of lobulus ansiformis and paramedianus bilaterally All potential activity recorded from the pial surface of the cerebellum evoked by superior laryngeal nerve stimulation resulted from a relatively brief, low intensity single shock representing the threshold for activation of the first component of the nerve-conducted potentials No responses could be found correlating with the higher intensities necessary to elicit the second component Varying durations and strengths of stimuli produced no change in the form of the cerebellar response

The cerebellar areas from which evoked potentials were recorded were exceedingly small (see Fig 1) In crus I the locus of responses measured usually 1 0 to 1 5 mm in diameter, in paramedianus, 0 5 to 0 75 mm The crus I projection area was consistently in the inferomedial angle anterior to the first folium of paramedianus Responses of the paramedian lobule were sharply limited to the medial one-third and the adjacent lips of folia III and IV Evoked potentials were not noted to arise from any other areas of the dorsal surface of the cerebellum

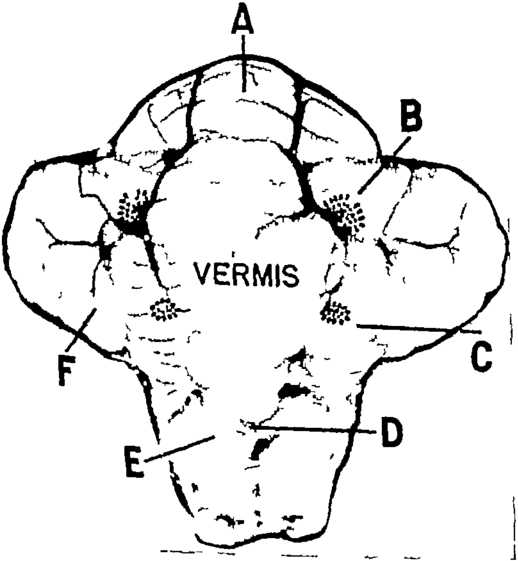

Fig. 1 Photograph of dorsal surface of cat cerebellum. The four stippled areas represent the loci of evoked potentials from afferent stimulation of the superior laryngeal nerve (A) Anterior lobe (B) Crus I of lobulus ansiformis. (C) Lobulus paramedianus. (D) IV ventricle. (E) Medulla. (F) Crus II of lobulus ansiformis.

The cerebellar responses were most frequently single monophasic positive spikes when the critical electrode was led against the periosteal electrode (see Fig 2A) This was most constant in the center of the locus Duplication of this potential (see Fig 2B) and occasional showers of small multiple spikes superimposed upon the basic response occurred in the periphery of the area activated (see Fig 2C, D, E)

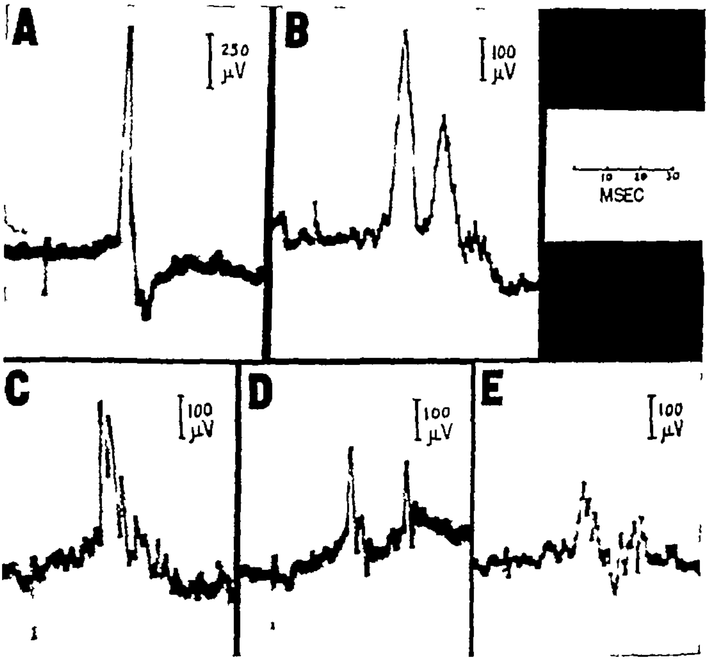

Fig 2 Photograph showing the various types of evoked cerebellar potentials from superior laryngeal nerve stimulation These responses were recorded from the posteromedial portion of the right crus I on supraliminal excitation of the ipselateral superior laryngeal nerve in cat No 1-17-52 (A) Single positive 1 mv response with a negative 250 µv component suggestive of diphasicity The more common evoked potentials were entirely monophasic (B) Duplicated positive 450 µv and 250 µv responses (C), (D) and (E) Multiple spikes there is superimposition upon a larger and more basic response in (C) and (E) The multiple spike potentials were of lower amplitude than the single and double responses and were recorded in the periphery of the projection area on crus I The latent period for above responses was 20 0 msec

Latent periods for the cerebellar response varied from experiment to experiment, due to variation in size of the animal, in temperature and moisture control, however, the latency recorded from stimulation of the superior laryngeal nerve to the beginning of the evoked cerebellar potential ranged from 20 to 30 msec. A difference of 0 75 to 1 0 msec.

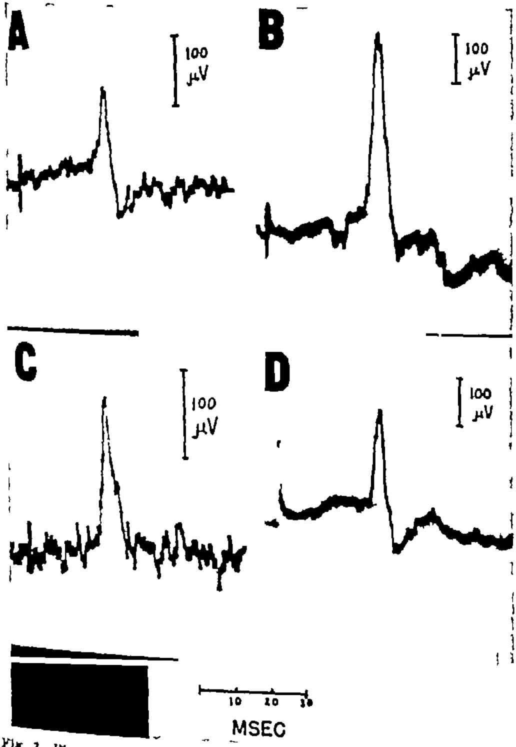

Fig 1. Photograph illustrating evoked responses from crus I and paramedianus bilaterally in the cerebellum of cat No 12 1 61 The left superior laryngeal nerve was stimulated (A) Diphasic positive negative response from left crus I with latency of 2 7 msec. Stimulus intensity 10 (B) Monophasic positive response from right crus I with latency of 6 5 msec Stimulus inten ity (C) Monophasic positive response from left paramedianus with latency of 3 2 msec Stimulus intensity 30 (D) Diphasic positive negative response from right paramedianus with latency of 2 4 m c. This experiment demonstrated evoked potentials from all previously observed laryngeal projection areas in the cerebellum from afferent stimulation of superior laryngeal nerve

was noted in the latent periods of contralateral and ipsilateral responses, the latter showing shorter time intervals Paramedian lobule potentials occurred about 2 0 msec earlier than crus I responses (see Fig 3A, B, C, D)

DISCUSSION

The cerebellar responses correspond to threshold excitation of those moderate size myelinated fibres which form the bulk of the superior laryngeal nerve These fibres had a conduction rate of 25-30 M/sec, and a cross-sectional diameter of 6-10 μ The wave component assignable to these fibres may be regarded as included in the "A" potential described for the cat vagus nerve (Heinbecker,[1] Heinbecker and O'Leary) Ordinarily, axones with the size seen in the superior laryngeal nerve are characterized by a more rapid conduction rate of 30-50 M/sec In the animal preparations used in this report, the slower conduction rates can be explained by cooling, as maintenance of constant temperatures of 37° C for each experiment was relatively impractical Such fibres usually mediate tactile sensation On the other hand, it cannot be ignored that the above "A" potential component may be consistent with visceral afferent functions, because fibre size and myelination may not correlate in all cases with conduction rates and specific physiological properties Heinbecker has pointed out the fact that "visceral nerve trunks practically always contain myelinated fibres of the second 'fast' somatic type which are afferent, the so-called 'visceral afferents' "

The sensory representation of the larynx in the cerebellum is not altogether surprising in view of the classical studies of Snider[3] showing extensive but delimited areas of the cerebellar cortex of the cat and monkey which are devoted to afferent functions Dow[4 5] and Adrian[6] have likewise revealed sensory projections to the cerebellum by peripheral nerve stimulation The loci of specific potential activity in crus I and paramedianus determined by excitation of the superior laryngeal nerve correlate well with the anatomical diagrams drawn by Snider to illustrate sensory projections to the cerebellar cortex Derived from the fourth and fifth arches as an evagination of the foregut in embryological development, the larynx should occupy theoretically a position between the face and upper extremity in terms of any sensory scheme projected to the central nervous system Snider found two separate areas in the cat cerebellum showing electrical responses to tactile stimulation of the face, forelimb and hindlimb *1* anterior lobe (posterior portion) overlapping crus I and lobulus simplex, *2* lobulus paramedianus overlapping crus II The body schemes were reversed in these two regions in *1* the face was most posterior, forelimb intermediate, and hindlimb most anterior The opposite was true for *2* in terms of anteroposterior orientation.

The experimental demonstration of laryngeal projections to crus I corresponds closely to Snider's face area, however, its projection to the medial one-third of the adjacent surfaces of the third and fourth folia of paramedian lobule is more in the forelimb area described by Snider

The shorter latent periods recorded for paramedianus and ipsilateral responses evoked by superior laryngeal nerve excitation suggest the factors of relatively decreased central transmission distance or less synaptic delay More exact explanation of this phenomenon depends upon more detailed investigation

Measurement of the distance between the point of excitation on the superior laryngeal nerve (at the proximal or cathodal stimulating electrode) and the site of entrance of vagal rootlets revealed values of 25-31 mm thus since the stimulus intensity of 1 activates the nerve component with a conduction rate of 25-30 M/sec. and also the cerebellar potential at the same time, it can be readily seen that only a small fraction of the total latent period can be related to impulse transmission along the superior laryngeal nerve nodose ganglion, and proximal vagal radicles From these observations a complex system with several relays between laryngeal nerve terminals and cerebellum may be inferred

In some experiments consistent responses were recorded from the medulla, probably indicative of the first synaptic station in afferent laryngeal functions Further work will be done to clarify what part these responses may play in central connections of laryngeal afferents

The exact significance of afferent representation of the larynx in the cerebellum at this time is not clear These experiments add to the speculation and re-examination of facts concerning cerebellar physiology precipitated in a large part by Snider and his co-workers The cerebellum probably participates on a subconscious level in the integration and coordination of the fundamental reflex arcs of the larynx The inflow of afferent discharges to the cerebellum may be highly important in the preservation of tonus in the vocal cords, constant stimulation of nerve endings in the epithelium of the cords in the normal physiological state may result reflexly in producing tension Irritation of touch and pain fibres in the laryngeal mucosa may produce reflex closure of the vocal cords, cough, or autonomic phenomena, controlled in part by the cerebellum in conjunction with lower brain-stem centers Smoothly coordinated phonation must infer intact cerebellar pathways, in which sensory projections must represent an integral part, the ataxic, scanning, and explosive speech of the multiple sclerotic is an outstanding example of the results of cerebellar disease reflected in phonatory dysfunction Afferent cerebellar connections may explain the syndrome of laryngeal vertigo, the pathophysiology of which is obscure

After more study and evaluation the cerebellum or "Kleinhirn" may actually be a structure less secondary to the cerebrum or "Grosshirn" than previously considered and particularly important in widespread integrative functions embracing all afferent discharges in the organisms

CONCLUSION

1 Bilateral afferent laryngeal projections exist in the paramedian lobule and crus I of the ansiform lobule in the cat cerebellum

2 The cerebellum probably plays a most important and hitherto unemphasized role as a coordinator in laryngeal functions.

We acknowledge the invaluable suggestions of George H Bishop Ph D James L. O'Leary M D and Theo E. Walsh M D., in the preparation of this work

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FIBROUS DYSPLASIA*

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Many articles have been written on this changeable disease under other titles, such as osteodystrophia fibrosa, juvenile Paget's disease, leontiasis ossea, osteitis fibrosa, von Recklinghausen's disease of bone, fibrocystic disease and osteitis fibrosa cystica

The main features of this disease are varied and are not always confined to the skeleton There appear to be three disconnected features *1* skeletal lesions affecting almost every bone in the body or affecting one bone or a few bones, *2* pigmented patches in the skin, *3* endocrine disturbances manifested by sexual and somatic precocity, especially in the female The essential clinical features of this disease, however, are skeletal and may or may not be accompanied by either or both of the other two

Fibrous dysplasia is one in a group of diseases in which softening, bending and fracture of the bones may occur In general, this group can be separated into two main divisions In one, the lesions are generalized in the bones with accentuations here and there which comprise the deficiency and endocrine diseases, rickets, osteomalacia, osteoporosis and hyperparathyroidism, and in this division, specific causes and means of prevention and cure are known In the other division, the lesions are more or less disseminated in the skeleton or even localized in a single bone comprising Paget's disease, dyschondroplasia, osteogenesis imperfecta and fibrous dysplasia, for none of which is there a known cause or a specific means of cure

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In 1885, the pathologic similarity between rickets and osteomalacia was pointed out, but not for many years was the common etiologic factor discovered. In 1877, Sir James Paget thoroughly described the clinical and pathological features of the disease bearing his name (osteitis deformans) The two hereditary diseases, dyschondroplasia and osteogenesis imperfecta, have become well establishd entities Von Recklinghausen,[1] in 1891, published a report on 16 cases of bone diseases, six cases of which he describd as fibrous osteitis, two of which can be accepted as fibrous dysplasia He included along with five cases of osteomalacia and rickets a case with widespread skeletal malacia, which is generally accepted as one of hyperparathyroidism, a parathyroid tumor having been subsequently identified from his material from this case Morton[2] in the United States in 1922 reviewed the literature up to date of that year, 63 cases in all, and recognized two main groups one of which was fibrous dysplasia and the other, hyperparathyroidism, but dismissed the findings of parathyroid tumor at autopsy as incidental

Elmslie's[3] reference to a nevus on the back of the neck in one of his cases was the first time that mention was made of extra skeletal features of the disease, and Weil according to Duff, Murray and Pritchard[10] reported a case of a nine year old girl who had pigmented patches on the skin and whose sexual and skeletal development was that of a girl of 15

About 1925, parathormone was discovered and soon experimental evidence proved that hyperparathyroidism caused osteitis fibrosa cystica, and at this time a parathyroid tumor was removed with startling results. Then von Recklinghausen's disease and hyperparathyroidism became synonymous but it was soon noticed that in many of these cases of osteitis fibrosa cystica of von Recklinghausen that neither parathyroid tumor or hyperparathyroidism could be demonstrated

In 1929, Winter[4] reported a case of generalized osteitis fibrosa cystica in the absence of parathyroid tumor Hunter and Turnbull[3] were the first to stress the distinction between generalized osteitis fibrosa of hyperparathyroidism and the osteitis fibrosa in multiple foci, particularly emphasizing that in the focal disease, even though many bones were affected the condition is totally different from the generalized disease and that exploration of the neck for parathyroid tumors is unjustifiable

Jaffe,[6] in 1933, reported that he had a residue of cases of osteitis fibrosa cystica without parathyroid tumors, of unidentified entity, and suspected that they had a congenital basis

In spite of Hunter and Turnbull's reference, in 1931, to the distinctiveness of the entity and how it differed from hyperparathyroidism, confusion between the two diseases prevailed and it was not until 1937, when Albright[7] and collaborators brought order out of the chaos, reporting on seven cases with severe skeletal involvement and skin pigmentation Of these, four females and one of the boys were considered precocious sexually All of the three males had previously been explored surgically for parathyroid tumors without any having been found They carried out thorough investigations, including metabolic and endocrinologic studies, and emphasized the focal nature of the lesions

Lichenstein,[8] in 1938, reported on eight cases in which there was no evidence of extra skeletal features but stressed the distinctive nature of the disease and its multiple focal distribution in the skeleton

In 1942, Lichenstein and Jaffe[9] were able to collect 75 cases from the literature and to describe 15 more of their own under the title, "Fibrous Dysplasia of Bone," inferring that the skeletal lesions are not necessarily polyostatic

Duff, Murray and Pritchard,[10] in reviewing the 256 cases reported in articles published between 1929 and 1949, found that the sexes are equally affected, leaving out Schlumberger's[11] 67 monostotic cases which were mostly in men from the armed forces There were 83 males and 82 females where the sex was stated In 148 cases ranging from four months to 70 years of age, the disease could be traced to infancy in seven cases, to childhood in 131, and to adolescence in 10 In many of the other cases, the appearance of the disease was of long duration That skeletal lesions can exist unnoticed even in widely disseminated form is shown by the not infrequent accidental discovery of the disease on radiological examination.

The first sign of the disease may be precocious menstruation but more often it is related to the skeleton in the form of a limp, a pain, or bending of a bone, particularly the upper end of the femur, a deformity of the face or skull, if the skull, it may be failing vision that first sends the patient to the physician. As a rule, the patients are reported as having a normal infancy with the exception of premature menstruation. Pigmentation of the skin was not reported as an attracting sign in 256 cases reviewed

There is considerable variation in the progress of the skeletal lesions, in the more severe forms, deformities may become disabling fairly early in childhood, usually reaching the maximum before maturity Progressive appearance of the foci in the skeleton is well authenticated insofar as they are demonstrable by symptoms and radiography Whether the foci are all established in marrow at the same time is not known, but individual foci extend and often coalesce. Continuity of activity may extend into adult life or manifestation of activity may occur only in adult life reactivation after long periods of quiescence is not uncommon

There are many variations in the bone lesions, but they are all within the potentiality of the skeletoblastoma to produce fibrous connective tissue, cartilage bone and synovial cavities and to shift back and forth between the productive and lytic phases of the metamorphosis of the bones and joints The process of fibrous dysplasia commences as a fibrous tissue proliferation within the medulla, replacing marrow and absorbing and replacing the cancellous and cortical bone Metaplastic bone is laid down in this newly formed fibrous tissue and occasionally islands of cartilage are developed and cysts may be formed

The microscopical appearances are described as newly formed fibrous tissue varying from place to place in its composition It may consist of small spindle and stellate cells and a fine fibrillar stroma in a loose or whorled arrangement, or it may appear in the form of intertwining bundles of larger spindle cells with plump vesicular nuclei and a varying amount of collagenous stroma On the other hand, it may be poor in cells and highly collagenous, often retaining a whorled or intertwining pattern Some areas may appear edematous and contain numerous small cystic spaces The vascularity varies markedly, the vessels being thin walled and of small caliber Dilatations of vessels may be seen with extravasation of blood, clumps of multinucleated giant cells and deposits of hemosiderin Clumps of giant cells may be seen, some with few or many nuclei, and should be looked upon as phagocytes Osteoclasts may be found about islands of cartilage and around fragments of bone in well vascularized areas, this being a manifestation of the lytic phase of bone building

Areas of fibrous tissue may escape ossification or bone may be laid down metaplastic in nature, appearing as shaggy small masses or irregular trabeculae, or it may appear in a more closely anastomosing trabecular arrangement, going on to form a dense, uniform, or irregular, fine or coarse honeycomb structure Osteoblasts may appear along the margins of the metaplastic bone trabecula, leading some writers to the opinion that the process is one of osteoblastic formation, but lamellar bone is not a prominent feature Most likely the osteoblasts play a part of smoothing off the irregular margins of the metaplastic bone trabeculae

It appears that there is an erosion of the normal preformed bone by the path of the advancing connective tissue without the presence of osteoclasts, so that the line of demarcation between normal preformed bone and pathological connective tissue is quite sharp The cortex becomes reduced to a thin layer and may ultimately disappear The fibrous tissue continues to proliferate, there being no bony reaction on the part of the periosteum except in the advent of fracture

The skeletal lesions may be a single lesion within a bone or a widely disseminated state with nearly every bone in the body involved In Duff and collaborators' review, the lesions were monostotic in 28 cases To date, Schlumberger's 67 cases of monostotic lesions is by far the largest group published In this group, the ribs were involved in 29 cases, the femur in nine, tibia eight, maxilla seven calvarium, five, mandible, two, humerous two, ulna, two vertebra, one, pelvis, one, and the fibula, one.

A flat bone may increase six to eightfold or more in thickness. The thickened and hyperostotic vault of the skull, chiefly as a result of replacement of the outer table simulates that of Paget's disease. The occipital and frontal bulges and grossly thickened, dense, hyperostotic bone are all very characteristic of the face or skull, thus failing vision may be the patient's first symptom On the other hand, precocious menstruation may be the first sign. A few may show pigmentation of the skin if so, it appears in infancy occurring on the back, buttocks, thighs, shoulders, chest, neck, face, or buccal mucosa scalp It may occur as small or large patchy areas, singly or in multiple areas of brownish cafe-au lait or yellowish areas. It occurrence increases with the severity of the disease, but is usually absent in the case of limited bone involvement. Duff and collaborators mention it as occurring in 79 cases. Jaffe, in his review of 90 cases, mentions it in 32 cases, while in Schlumberger's 67 monostotic cases it was absent though Bennett has observed it in monostotic lesions

A very important diagnostic feature of the disease is its focal nature in the skeleton. Uninvolved bones or parts of bones between the foci of disease retain their normal structure, which is in striking contrast to hyperparathyroidism in its effect on the whole skeleton by the process of the absorption of bone An affected bone may retain its normal bony structure and show only a focal replacement of the marrow by a solid fibrous mass containing more or less bone or the cortex becomes reduced to a thin layer and may ultimately disappear — the fibrous tissue continues to proliferate there being no bony reaction on the part of the periosteum except in the advent of fracture, thus the bone may or may not be expanded The gross appearance of the bone may be pale, pink or cyanotic and may be gritty to cut as a result of new bone formation within, or areas of marble-like bone may be encountered, being so hard as to turn the edge of an enterotome Areas of hemorrhage, cartilage, or cysts may be recognized

Lesions of the skull usually assume a hyperostotic state, usually the base becomes greatly thickened and dense and bulges upward into the cranial cavity The vault thickens chiefly by replacement of the outer table The process may be diffuse with the head enlarged symmetrically or it may be focal, causing marked asymmetry Large occipital and frontal bulges are not uncommon Extension forward leads to facial deformities and obliterates the sinuses and nasal passages, separating the eyes and displacing them in a horizontal or vertical plane or causing proptosis Encroachment of the foramina in the base of the skull may cause optic atrophy and diminution in vision and hearing

In the X-ray, the area of fibrous dysplasia is radiolucent, sometimes transversed by delicate trabeculae of bone, varying according to pattern and distribution of the new bone and its calcification One may find alternating areas of translucency and increased opacity It is usually central in position and produces thinning and expansion of the cortex As cortical absorption progresses, the appearance will be that of a bone covered by a thin cortex and when complete absorption occurs, the core of the fibrous dysplasia will be covered by periosteum with no distinction between cortex and medulla

Blood chemistry findings are essentially negative, the calcium and phosphorous levels in the blood serum are normal, and a negative calcium balance does not occur in fibrous dysplasia

In females, precocious menstruation is a common accompaniment of the skeletal lesions and is usually associated with pigmentation of the skin

In males, sexual precocity is very much less common and was recorded in only five cases against 32 cases in the females in the review by Duff and collaborators[10]

The majority of the cases were normal mentally, though five patients were described as mentally retarded in Duff's[10] review

In the past few years we have observed five cases, one or two of which show interesting features

REPORT OF CASES

Case 1 N S., a 19-year-old white male admitted to hospital January 1949 complaining of a lump in the right side of the lower jaw for the past two and one-half months and for the past month a lump in the left lower jaw They have gradually increased in size now are about 6 cm. in diameter and are not tender Examination shows a firm swelling on external surface of right mandible opposite two premolar teeth non tender measuring about 6 cm. in diameter and not involving the skin. The one in the left mandible is somewhat smaller and situated in about the same area.

X-ray report (see Fig 1) shows two large radiolucent areas in the ramus of the mandible the right being larger than the left. On the left side the radiolucent area involves the ramus of the mandible below the apex of the first molar tooth and seems to extend upward between the second bicuspid and first molar On the right side the radiolucent area is a little farther anteriorly extending from the first bicuspid forward to lateral incisor The cortex of the mandible is almost paper thin with no evidence of any reaction It would appear that there are radicular cysts. The fact that the teeth are fully developed and seem to be outside the cyst excludes their being dentigerous cysts.

Operation January 1949 Lower right cuspid first and second molars removed, an incision was made along the length of the alveolar crest, revealing thin cortical bone in which was a fibrous mass which could be readily enucleated. The mass was not removed from the left jaw awaiting biopsy reports on the tissues from the right jaw

Pathological report (see Fig 2) shows a dense collection of cells arranged in whorls and streaks for the most part, with abundant cytoplasm and fusiform nuclei. These are probably of fibroblastic origin Interspersed are collections of cells with more circular and pale staining nuclei, but these are in the minority There are a few cystic spaces present filled with cellular debris here and there are small homogenous densities taking a polychromatic stain which resembles bone. No giant cells seen. Diagnosis fibrous dysplasia.

Following this X rays were taken of the long bones and skull but no evidence of other tumors was found. The mass from the left jaw was later removed the pathological diagnosis being as above

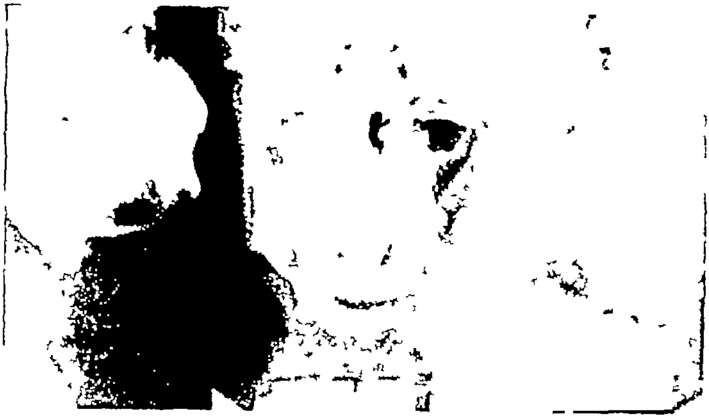

Fig 1

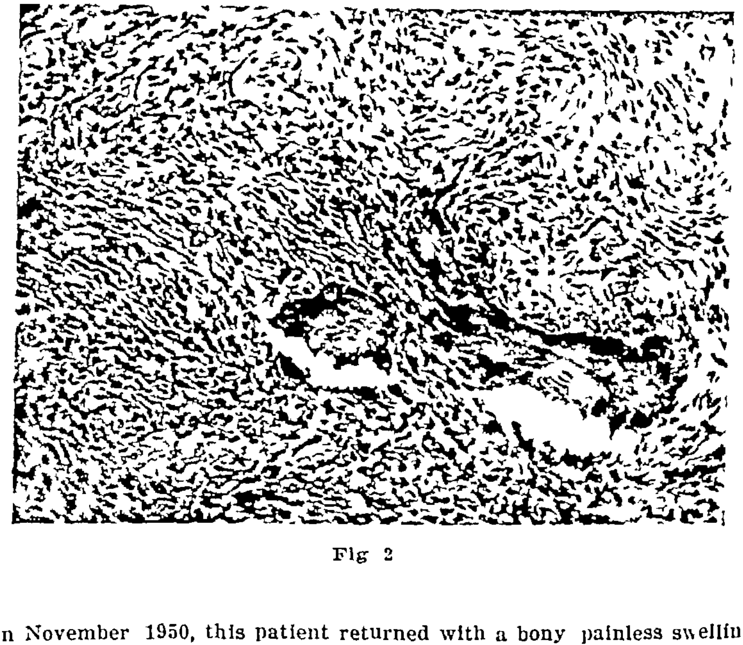

Fig 2

In November 1950, this patient returned with a bony painless swelling in the left side of the hard palate of six months duration X rays (see Fig 3) show a tumor mass involving the left antrum with displacement of the nasoantral wall Biopsy taken through left canine fossa Pathological report fibrous dysplasia

Further X rays were taken of the skull and long bone in which the findings were negative The serum calcium and phosphorous levels of the blood were negative however it is of marked interest that this man s sister was in the hospital six months previously for the removal of a parathyroid tumor with widespread skeletal involvement.

Operation November 1950 by means of a left Caldwell Luc approach the growth was removed. The antrum was filled with what appeared to be fibrous tissue with a bony trabeculae which were almost like the cell partitions of a mastoid.

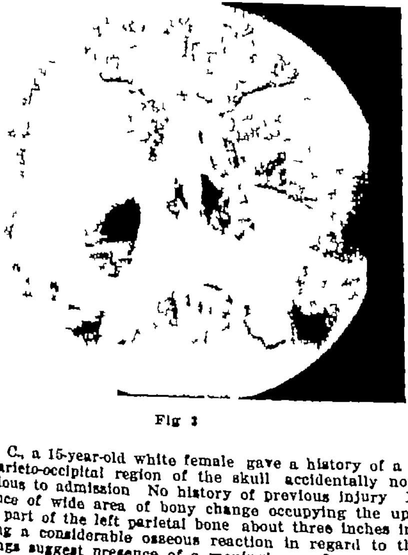

Fig 3

Case 2 A. C., a 15-year-old white female gave a history of a painless lump left parieto-occipital region of the skull accidentally noticed 18 months previous to admission No history of previous injury X ray of skull evidence of wide area of bony change occupying the upper and midposterior part of the left parietal bone about three inches in diameter producing a considerable osseous reaction in regard to the outer plate Findings suggest presence of a meningioma Operation October 1949 When skull comprising the tumor was lifted from the dura there was no evidence of meningioma, but a rather soft granular tumor of the bone bluish in color Pathological diagnosis fibrous dysplasia Bone is present in trabeculae between which are masses of fully formed adult fibrous tissue there is no evidence of diploe but there is evidence of proliferative and degenerative changes.

Case 3 J S A., a 21 year-old Japanese male. History of painless gradually increasing swelling of the left cheek, 12 years. No history of injury Examination reveals a hard mass involving anterior wall of left superior maxilla and extending into zygoma The infraorbital ridge appears to be pushed upwards, and the nasal bones appear to be pushed to the right, the hard palate on the left side is also involved There was no exophthalmus or diplopia

X ray report (see Fig 4) The left malar bone is increased in size It is homogenously dense The density extends laterally through the anterior half of the zygomatic arch, and medially it encroaches upon the lateral half of the left maxillary sinus The medial portion of this sinus is aerated The floor of the left orbit is elevated in its anterior rim. Biopsy revealed fibrous dysplasia

Fig 4

April, 1951, mass removed under general anesthesia by left Mouré incision Spongy tumor removed involving left antrum roof of orbit, anterior two thirds of hard plate and anterior one-third of zygoma

Microscopically the section showed a dense network of wide bone trabeculae The dense fibrous connective tissue fills the marrow cavities All the bone is of a friable woven type, the bone cells being unevenly dispersed in the matrix through which fine fibrillar markings are distributed This trabecular change extends right to surface of the lesion there being no true cortex between it and the overlying muscle (see Fig 5)

Case 4 N P a 44 year-old white female Since 1932 and subsequent 14 years has had a swelling of the right cheek Physician made a diagnosis of acute maxillary sinusitis with operative drainage 1935 but swelling never entirely subsided Tumor did not progress in size until 1945 when it apparently involved the right zygomatic region and right temple with periodic pain in the region of the right antrum right temporal region and right ear Admitted to Toronto General Hospital 1946 X rays of skull (see Fig 6) and sinuses show a bony lesion involving right zygoma, maxilla, greater and lesser wings of sphenoid on the right

Fig 5

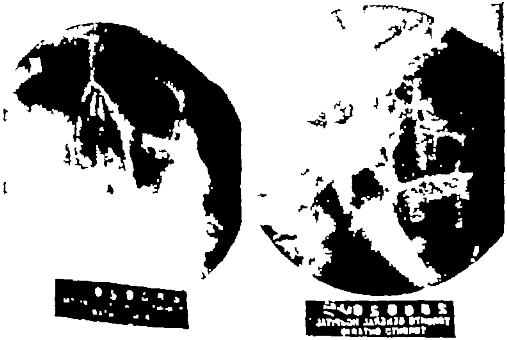

Fig 6

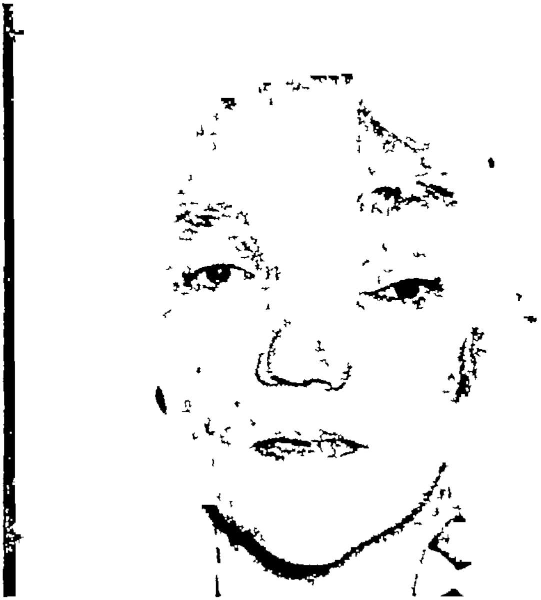

Fig 7

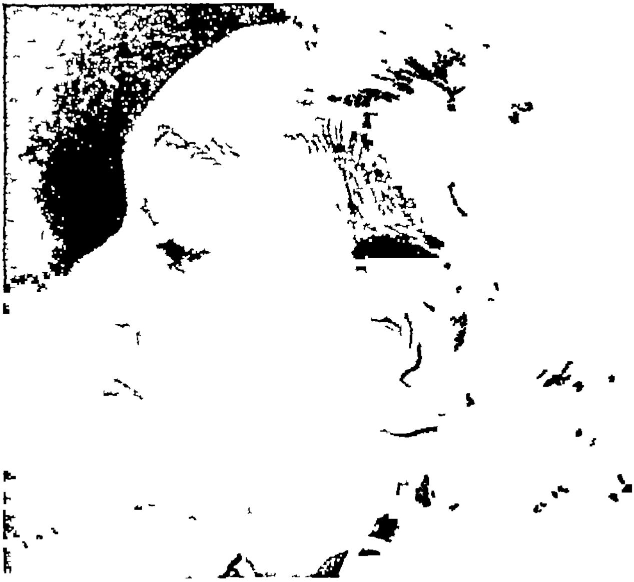

Fig 8

side, the squama of the right temporal bone and the supraorbital ridge of the right frontal bone Biopsy taken through right canine fossa Pathological diagnosis fibrous dysplasia. Moderate cellular fibrous tissue small masses of bone scattered through the fibrous tissue a few blood vessels present. A considerable number of multinucleated osteoclast seen around the edges of many Haversian canals which are distended with fibrous tissue. X ray therapy was carried out without any effect.

Case 5 D. W A 43-year-old white female married mentality that of a high grade moron. One child six years old attending a school for the deaf. First seen in 1933 and gave a history of being pushed against a wall, injuring her face at the age of 16 years Examination reveals a hard, bony mass involving the left nasal bone floor of the left orbital and left frontal bone with marked prominence of the supraorbital margin The space between the eyes is increased and the left eye is displaced downward (see Figs. 7 and 8)

There is no diplopia or proptosis Examination of the nose reveals that the left middle turbinate is markedly enlarged and hard and has been pushed downwards almost to the floor of the nose—the ethmoid sinus has been obliterated

Fig 9

There is an irregular cafe au lait pigmented area on the left buttock 4 by 3 cm The patient gives a history of menstruation at five years of age

X ray examination shows a well marked thickening (see Figs 9 and 10) and increased density of the base of the skull In the frontal bone, the diploic space is markedly widened and shows irregular areas of density and translucency This process extends downward to produce a marked prominence of the supraorbital margin on both sdes and also extends medially to the orbit on the left side The space between the orbital cavities is markedly increased

Fig 10

X rays were taken of the long bones and pelvis which were negative The serum calcium and phosphorous levels of the blood were negative

Biopsies were taken from the frontal bone above the left eye and from the left middle turbinate Pathological diagnosis fibrous dysplasia (see Fig 11) showing spicules of bone within whorls and strands of fibrous tissue and a section from another area Fig 12 shows a mass of dense sclerotic bone

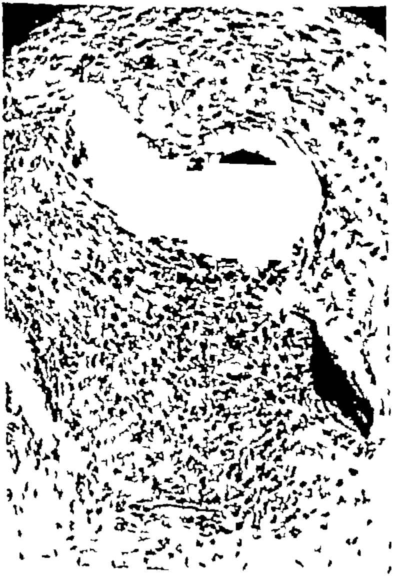

Fig 11

SUMMARY

Five cases of fibrous dysplasia are reported, the correct diagnosis was made only on pathological report

The lesions were asymptomatic except in one case, and in only one instance was it related to trauma

In one of the male cases, a family history showed one sister having had a parathyroid tumor with widespread skeletal lesions This case was also interesting in that he returned with a lesion in the antrum and hard palate 18 months after his original lesion had been removed

Marked hyperostotic changes occurred in the skull in one instance, in this case pigmentation of the skin was present, and a history of precocious menstruation

Most writers believe that the manifestations of the disease are congenital There is no histological evidence suggesting that the disease is neoplastic in that mitosis or atypical cells are not present Schlumberger feels that localized monostotic fibrous dysplasia is always a response to injury and, therefore, inflammatory in nature, Towson[12] reported a case of monostotic fibrous dysplasia of the mastoid bone in which there was a previous history of trauma, but other writers are at a loss as to whatever stimulates the continual activity of the undifferentiated fibrous tissue and most writers feel that the monostotic forms of the disease are a limited form of the polyostotic fibrous dysplasia It is a chronic, slowly developing disease which manifests itself generally in childhood and persists throughout life but frequently is quiescent in the adult

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AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY HOME STUDY COURSES

The 1952-1953 Home Study Courses in the basic sciences related to ophthalmology and otolaryngology, offered as a part of the educational program of the American Academy of Ophthalmology and Otolaryngology, will begin on Sept 1 1952, and continue for a period of 10 months Detailed information and application forms can be secured from Dr William L. Benedict, executive secretary-treasurer of the Academy, 100 First Avenue Building, Rochester, Minn Registrations should be completed before Aug 15

THE PROBLEM OF THE PRESCHOOL DEAF CHILD

(Diagnostic Methods and the Otologist's Role in His Rehabilitation) *

JOHN E BORDLEY, M D (by invitation),
Baltimore, Md

Impairment of hearing in the preschool child poses two problems to the practicing otologist First, he must have at his command the means necessary to determine the fact that the child has a hearing impairment If possible, he should learn the type of hearing loss and the degree of that loss Second, he must be able to help the parents plan for the child's future Such planning should include not only the medical measures that might be indicated to improve the hearing but also a communicative training program for the child with the doctor acting as counselor It is proper that the otologist assume this position as advisor because such a doctor-patient relationship has, through the years, proved most successful in keeping family cooperation during a long range training program It is to the doctor that families in difficulties bring their children, and it is their faith in his ability to diagnose and advise that is the foundation stone on which the science of audiology should be built To be useful in such a rôle, the otologist should have an understanding of the problem of language and speech training as well as those of the science of otology

To make the diagnosis of hearing impairment in a group of preschool children is not easy It is time consuming, frustrating and, in many instances, it results in the otologist's being more hopeful than sure that he is right A diagnostic process in such a group of children should include a complete and detailed history which covers the family background,

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prenatal and birth history, etiological factors predisposing to hearing impairment, and the developmental pattern of the child. In many instances, such a history will reveal the necessity of psychiatric consultation to aid in evaluation Included in any diagnostic procedure must be a careful physical examination of the ears, nose and throat. Finally, every possible available means should be employed to obtain accurate determinations of the child's hearing levels All the data thus assembled must be assayed before any final diagnosis can be made.

Five hundred thirteen children under the age of six years have been examined during the past two and one half years in the Hearing and Speech Clinic at Johns Hopkins Hospital The median of this group lies in the third year It might be well to review the practices evolved for the examination of these children and to discuss briefly some of the findings in this group In order to make a comprehensive coverage of the patient's history, a questionnaire has been developed (see Fig 1) This inquires into *1* The family background *2* The prenatal and birth history *3* The diseases, accidents and operations of early childhood *4* The general developmental history, including social maturity and hearing and speech progress. In general, we have found the mother the most satisfactory individual to interview when filling out these questionnaires. After the questions have been answered, the child receives a complete otological examination including inspection of the nose nasopharynx and Eustachian orifices with the electric nasopharyngoscope The child is then taken to the playroom where his performance with games and toys is observed General performance tests are given including some of the Gesell Development Series Children with suspected mental retardation or suspected emotional disturbances are referred to the Children's Psychiatric Clinic for further evaluation The hearing examination is divided into three general types *1* the tuning fork tests, which include both bone and air conduction, *2* observations made while the child is in the soundproof room introducing monitored sound effects, words and masking noises through a loud speaker

FIG 1

PERTINENT FACTS FOR THE HISTORY OF A YOUNG CHILD WITH SUSPECTED HEARING LOSS

Sex	Birth Date	Age	Years	Months

FAMILY HISTORY

1 Hearing impairment in family—age of onset in ancestors 2 Age of siblings—list of any defects 3 Miscarriages

HISTORY OF PREGNANCY

1 Rh compatibility, 2 Illness during pregnancy (particular attention to infections by viral diseases and unexplained high fevers) 3 Immunization during pregnancy 4 Bleeding 5 Toxemia 6 Premature delivery

DELIVERY

1 Normal long—short 2 Induced forceps—high—low drugs

POST DELIVERY

1 Normal appearance of infant 2 Abnormal appearance anatomical deformities paralysis cyanosis jaundice

GENERAL HEALTH

1 Serious illness convulsions loss of consciousness 2 Children s diseases—age 3 Unexplained fevers—age 4 Illness associated with immunization—age 5 Serious injuries—age

E N T HISTORY

1 Otitis media 2 Mouth breathing 3 Tonsillitis 4 Allergies 5 Operations, 6 Frequently recurring colds

DEVELOPMENT

1 General
  a Age of onset of walking
  b Age of self feeding
  c Age of toilet training
2 Speech and language
  a Age of onset of speech
  b Normal babble did it stop? when?
  c When did child use two word sentences?
  d Is speech understandable?
  e Does child understand without gesture?
  f Is vocabulary development reasonable?
3 Hearing
  a Response to noises in local environment
  b Response to conversation, to calling—what distance?
  c Attention paid to radio—to T V
  d Other indications of awareness of sound
4 Social maturity
  a Self management of clothes and toilet habits
  b What are typical play activities?
  c How adjusted toward other children?
  d Temper tantrums?
5 Education or group experience
  a Level
  b Progress

When the child has language, object identification is tried, using monitored voice. No attempt is made at this time to obtain any unilateral hearing evaluations 3 Audiometry This consists of both psychogalvanic skin resistance audiometry[1] and pure-tone subjective audiometry All of the 513 children under discussion have been examined with psychogalvanic skin resistance audiometry Where the cooperation of the child made it feasible, subjective audiometry has been attempted

Psychogalvanic skin resistance audiometry is well described in two recent paragraphs written by Dr W G Hardy and Dr Stacy Guild[2] ' By means of measuring changes in sweat gland activity it is possible to determine thresholds for pure tones, even in very young children After a child, or an older person, is given a mild faradic shock a few seconds following a test tone, and the experience is repeated five to 10 times, increased sweating occurs before the shock is given This physiologic fact is the basis for the test-method known as psychogalvanic skin resistance (PGSR) audiometry Once this conditioning is established, the shock is omitted and the test tones are presented as in standard audiometry, from which the method differs only in the manner of observing the patient's responses. Instead of raising a finger or pushing a button, the patient sweats if the tone is heard, and the presence or absence of this response is recorded by an ink writer on a roll of paper Precisely what causes the sweating is unknown. This phenomenon has been known however since Fere's[3] work in 1888, and has been widely used since in many different kinds of psychobiologic measurements "

An analysis of the etiological factors underlying the hearing impairment in 485 of the 513 children examined in the Hearing and Speech Clinic can only be briefly scanned today The 485 children are those with a known hearing loss Twenty-eight of the children examined in the group under discussion had no evidence of hearing loss when studied by the above methods (see Fig 2) In this analysis 28 categories have been established. Some of them such as cerebral degeneration, are rather loose and may later have to be broken down

FIG 2

TOTAL NUMBER OF CHILDREN UNDER SIX YEARS OF AGE—513
NORMAL HEARING 28
IMPAIRED HEARING, 485

Analysis of Etiologic Factors Underlying Impaired Hearing of 485 Children

Etiologic Factor	Number Children
Familial	18
Erythroblastosis (Rh Incompatibility)	29
Prenatal Rubella	24
Prenatal Hyperpyrexia	2
Prenatal Immunization	4
Prenatal Diabetes	1
Toxemia of Pregnancy	5
Anatomical Developmental Anomalies	16
Birth Injuries	13
Cyanosis at Birth	13
Cerebral Degeneration	26
Cerebral Palsy (No Known Rh Incompatibility)	32
Infant Diarrhea	1
Meningitis	43
Measles (Rubeola)	31
Whooping Cough (Pertussis)	8
Chicken Pox (Varicella)	6
Mumps (Epidemic Parotitis)	5
Scarlet Fever	2
Pneumonia	4
Jaundice Postnasal	3
Typhoid Fever	1
Poliomyelitis	1
Unexplained Hyperpyrexia	37
Neurotropic Chemicals *1* Lead *2* Citronella	2
Streptomycin	1
Middle Ear Lesions (Not Anatomical Anomalies)	17
Cause Undetermined	140

The largest single group is that in which no specific etiological cause could be determined This includes quite a few adopted children whose past histories were unknown, so that complete data was unobtainable The two classifications that have been of particular interest to us include the four children born of mothers who received immune globulin during the first trimester of their pregnancy and the cyanotic group The four women immunized during the first trimester of their pregnancy showed no evidence of measles, and it is quite questionable just how severely exposed three of them were The fourth was definitely not exposed to measles, but was given immune globulin after one of her children developed poison ivy, which apparently was incorrectly diagnosed on the first day and later never resembled measles The findings in these four children lead us to believe that some of the present work being done on prenatal immunization in some of the obstetrical and pediatric clinics should be assessed with the greatest care. Of the cyanotic group, all 13 of these children required prolonged oxygen therapy Reviewing the picture as a whole, prenatal rubella, erythroblastosis and meningitis are still among the greatest contributors to the problem that faces us today

Those people working on the problems of etiological factors predisposing to deafness will, undoubtedly feel that the foregoing classification is not definitive It was created only as a skeletal framework which can be added to or changed as our knowledge accumulates, in the Hearing and Speech Clinic, it has been modified considerably in the past three years.

Of the 513 children passing through the clinic, when the 28 normals had been excluded, the remaining children have an average mean "speech potential" of 57 8 db Such "speech potential' is arrived at by using the average loss in decibels for the pure-tones 500, 1 000 and 2 000 cycles in the better ear of the examinee. The figure 57 8 db is better than one might expect in such a group It is important because it means that children having such an average loss would have a fair prognosis for training with amplification Useful amplification means that the child will have an advantage in speech development Early discovery of such a hearing loss which can be helped by amplification means that the child has an opportunity to develop usable speech during his early years

Such an acquisition of speech very frequently means that, with special courses to improve the communicative function, a child may be admitted to a normal educational program

The careful evolution of an accurate diagnostic process is necessary if eventually we are to learn the degree and cause of the child's hearing handicap Such a determination is only a part of the responsibility of the otologist All of his findings must be interpreted to the parents The degree of hearing loss, the type of loss, and the cause of that loss are all very important and necessary information to them They should be told if anything can be done medically to help their child The family must learn what their child's handicap will mean to the interrelationship in their family group They should understand what their child's hearing impairment has contributed to its past development, especially when that development has seemed deviant from that of a normal pattern They should realize what this handicap may mean in the child's future social adjustment Such insight is necessary to both the doctor and the family in working out the pattern for the child's future education It is such a program, set up early and intelligently, that so often means the difference between a normal and an abnormal upbringing Early study and comprehension of the child's hearing loss offers our best chance to overcome the handicaps inherent in such a disability

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RECRUITMENT AND SPEECH DISCRIMINATION LOSS *

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The important role of the recruitment factor for the comprehension of speech in certain cases of perception deafness has been emphasized previously by one of us [1,2] On account of theoretical considerations,[3] *a priori* was to be expected that a rather critical intensity level for optimum speech intelligibility combined with a critical distance for optimum speech understanding capacity for conversational voice might exist in connection with the recruitment phenomenon

The occurrence of such cases was recently stressed again by the less satisfactory application of electronic aids on hard of hearing individuals, whose loudness loss presents a typical regressive character for stimuli of gradually increasing intensity and also by the less successful results of auditory training in young children (*cf* 2, item 11) with the same type of hearing impairment following meningitis, streptomycine etc. This last point has been confirmed recently by the work of Wedenberg[3] An explanation[2] of these phenomena can be found in the subjective distortion engendered by this type of pathological loudness perception (pathological subjective distortion)

For the purpose of a better insight into this problem a series of experiments was set up which are described *in toto* in a thesis by one of us,[4] and in which case reports also are given The principle of speech audiometry by applying the Groningen P B lists to a high quality sound reproducing system with a uniform frequency characteristic and a linear intensity response circuit was used

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* From the Audiology Department of the University Ear Clinic Groningen Netherlands.

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Two types of articulation curves have previously been differentiated by Davis[5] and Silverman[6] (see C-type and P-type in Fig 1) The experiments revealed a third type, which could be related to the recruitment phenomenon (see R-type, Fig 1)

1 C-type—pure sensitivity loss, which means that the hearing function for speech may be restored to normal (N) merely by adequate amplification This type is typical for conduction deafness In these cases the articulation curve is simply shifted over a distance corresponding to the average threshold loss for pure tones in the speech region

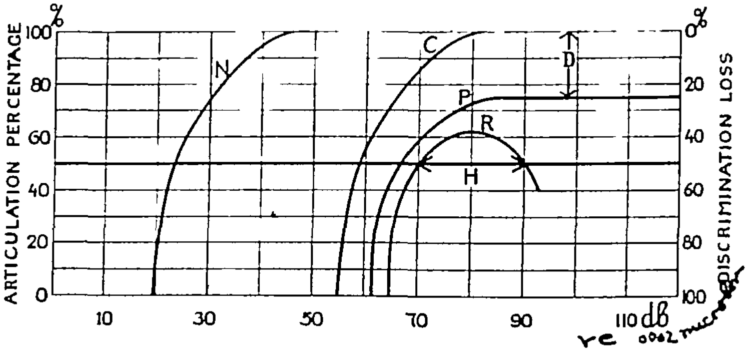

Fig 1 Articulation curves (N) Normal ear (C) Pure conductive impairment (P) Perceptive impairment with constant value of (D) (R) Perceptive impairment with variable value of (D) related to recruitment. (H) Half way width

2 P-type—sensitivity loss combined with loss of discrimination (D) caused by a perceptive type of hearing loss In such a case the articulation percentage does not pass a certain maximum value, after a steep rise the articulation curve merges into a horizontal line, the so-called saturation level The analysis of speech is now restricted to a limited number of speech elements From this we can understand that the operational range of the aided ear is still confined to a limited distance, depending upon this saturation level It is also obvious why speech reading is very valuable in these cases because of the combined effect of visual and acoustical clues

3 R type—sensitivity loss combined with loss of discrimination by preponderating subjective distortion due to a pathological loudness function (recruitment)

This type of articulation curve shows a typical optimum region of intelligibility When the optimum listening level (80 db in Fig 1) is passed, a rapid fall of articulation score is found. The recruitment phenomenon causes a steep rise of the loudness perception of the proffered speech as soon as the threshold of detection is passed The articulation score, however, does not keep pace with this loudness sensation, inasmuch as the curve presents a resonance-hump which may be more or less broad At high intensity levels this results in a discrepancy between the loudness of speech and its intelligibility

The area of the helmet shaped" upper part of this curve—*chapeau de gendarme*—with the 50 per cent level as a borderline, determines the social adequacy index[5] of the impaired ear When fitting a hearing aid, the ' halfway width" (H) of the curve—the baseline of the helmet—and also its height, should be made as great as possible by auditory training before making the final choice The figure H is as important as D since H determines the width of the area over which a hearing aid user can manage with his instrument by a certain setting of its volume control

This R type of articulation curve should not be confused with the same type of bent curve mentioned in literature,[7] which apparently is connected with *objective* distortion It is well known that amplification circuits as used in conventional hearing aids provoke a certain amount of harmonic distortion which may involve even a large discrimination loss for the aided ear when the circuit load is gradually increased Consequently, an artificial discrimination loss is introduced, which then appears also in cases of pure conduction deafness,[7] whereas the same ear would not show such a loss if high quality laboratory equipment had been used for the speech tests.

Even in the normal ear the articulation curve represents a downward trend at very high intensity levels when standard laboratory equipment is used This small discrimination loss can be considered as a normal subjective distortion on a pure *physiological* basis which may be neglected in comparison with the *pathological* subjective distortion caused by the recruitment symptom

Although the R-type might be considered as a special case of the general P-type, it has been split up because of the predominating influence which the speech intensity exerts on the value of D This is specific for recruitment

The regular P-type with its saturation effect presents a *constant* value of D, which may have various causes

a Complete drop-out of a certain part of the frequency scale (dip or abrupt threshold-audiogram)

b Subjective masking (sloping type of audiogram, tinnitus) In a sloping type of audiogram the low components of speech prevail over the weak high tones, resulting in an obliteration of the treble part The voiceless consonants are always masked in these cases and as the slope of the curve increases, a larger part of the gamma will be involved

In the normal ear the *center of intelligibility* is at about 1,500 cycles per second In a sloping audiogram this center dips more and more as the slope of the curve increases This means that the serviceable part of tonal range is limited to a more or less narrow region in the bass Consequently, the value of D increases

c Tonal dispersion and fuzziness by partially delayed[8] analysis (presbyacusis) or by asymmetrical analysis (diplacusis)

In many cases the above mentioned *constant* types of discrimination loss will be mixed with the *variable* R-type The occurrence of this type of articulation curve in connection with recruitment has been confirmed recently by Azzi[9]

It has been advocated that peak-clipping and automatic volume control circuits are apt to compensate for recruitment phenomena This is true so far as concerns the prevention of uncomfortable loudness levels, for which these circuits operate as a vent, however, they do not counter-balance subjective distortion Peak-clipping has no substantial influence on the articulation score of a normal ear although it involves a certain amount of objective distortion Combined with subjective distortion, however, intermodulation effects may enhance considerably the value of D at the right part of the helmet-shaped curve

The existence of the variable type of discrimination loss has been connected to speech intensity up to now, but naturally the change of D, *i e*, the shape of the curve, will depend also upon the type of frequency response characteristic used This is especially true when the subjective distortion originates from a somewhat narrow band of the tone scala If such a band can be suppressed, the variable type of curve may change into a constant type in which the saturation level exceeds the optimum level of the original This would increase the practical value of a hearing aid

Although recruitment is still a complicated matter *band-clipping—e g* partial suppression—seems to be an advantageous procedure for certain cases with a more or less flat threshold audiogram, that still covers the complete gamut. Then the frequency response characteristic should be chosen so that the center of intelligibility is moved to a part of the frequency scale, in which the subjective distortion is as low as possible while the contributing band-width still remains large enough to obtain better conditions

The data on 15 cases of the R-type using uniform and linear amplification present an intensity spread from 70 db to 90 db for the optimum listening level The average of about 80 db may provide a useful figure for an adequate volume control setting for auditory training of young children whose hearing impairment is characterized by the recruitment phenomenon furthermore it seems advisable to recommend an intensity response characteristic with a stabilized output Such children would stay behind in speech development if the gain of their hearing aids would be raised to very high levels as is necessary in cases without recruitment To a certain extent the poor results of auditory training in these children may be explained by the fact that the recognition of the proffered speech elements depends greatly upon the rather critical value of the speech intensity level

It may be concluded that in all cases of perception deafness more information about the loudness function of the organ should be collected

SUMMARY

Speech audiometry using Groningen P B-lists presents three types of articulation curves (C-type, P-type and R-type) The R-type, characterized by a kind of resonance-hump, can be related to the subjective distortion caused by recruitment

The variable type of discrimination loss embodied in this R-type can be defined by the discrimination loss D and the halfway-width H In connection with the constant type of discrimination loss (P-type) three kinds of hearing impairment are considered

The influence of objective and subjective distortion on the articulation curve is discussed Subjective distortion may be of pure physiological as well as of pathological origin

Peak-clipping and automatic volume control circuits do not compensate for subjective distortion By means of band-clipping the center of intelligibility can be moved sometimes to a part of the frequency scale in which the subjective distortion can be neglected

The average optimum listening level of 80 db may provide a useful figure for auditory training of young children whose impairment is characterized by the recruitment phenomenon

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182 Oostersingel

1952 SUMMER MEETING, VOLTA SPEECH ASSOCIATION FOR THE DEAF

The 1952 Summer meeting of the Volta Speech Association for the Deaf will be held in New England, June 16-20, 1952 Theme That the Deaf May Speak."

The program will begin on June 16 in Northampton, Mass , when the Clarke School will welcome our Association members with a series of demonstrations The Clarke program will end Tuesday at noon and the opening session of the main convention will be held Tuesday evening June 17 at the Hotel Kenmore, 490 Commonwealth Avenue, Boston at 8 p m

The program will continue Wednesday Thursday and Friday at the Horace Mann School and the Hotel Kenmore

Members may register either in Northampton Mass or Boston.

Nathan P Harris Program Chairman

DESTRUCTIVE CARCINOMA OF THE NOSE FOLLOWING A STAB WOUND

ALBERT B SELTZER, M D ,
Philadelphia, Pa

Malignant growths of the external nose are very deforming unless they are treated by early eradication Since the epidermoid cancers, with which this paper is concerned, are slow-growing and run their early course as shallow, gradually-spreading ulcers, they are often wrongly diagnosed and neglected They occur wherever there is transitional or squamous epithelium, both externally and in mucous membranes

Such malignant growths of the skin were formerly known as epitheliomas They are often caused by irritation or injury, particularly if the former is of moderate degree and frequently repeated The growths first appear as a small, focal thickening of the skin, which may become nodular, and which breaks down at the center with ulceration, or they may also develop in the margin of chronic ulcers, that in the beginning show no sign of malignancy The malignancy is indicated by their tendency to infiltrate the surrounding tissue and to spread by metastasis

Epidermoid malignancy occurs with about equal frequency in both sexes The bodily changes that occur with ageing appear to be a factor in their occurrence, since they arise more often during the involutional period, from 45 years onward Exceptionally, they may occur during early life

Epidermoid carcinoma must be differentiated from dermoid cyst, which it may sometimes resemble, but which is a benign process The latter formation may be congenital, or it may be a result of a penetrating injury, in which a small group of cells from the germinative layer of the skin is embedded in

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the underlying tissue This fragment of skin tissue thus becomes more or less analogous to a tissue culture The buried cells continue to multiply, and since they are closed in below the skin surface, the cells which normally form the cuticle accumulate with a resulting cyst formation. There is no tendency to infiltration or to spreading by metastasis, therefore, they are not malignant

In the absence of injury, the skin of the nose and face are frequently sites of new growths, both benign and malignant. They may start as simple keratoses in the elderly and go on to later ulceration if infiltrated Others may appear as a small nodule in the skin, which in time becomes umbilicated and later breaks down, forming a chronic ulcer Only when these ulcerating skin areas begin to increase in size and abnormal cells start to infiltrate the surrounding tissue is malignancy demonstrable.

The case considered here is that of a man of 75 years of age. He has been a prison guard for many years, and 20 years ago he was stabbed in the nose The long delay in the appearance of definite malignancy, together with the nature of the injury, make this case of more than usual interest

Before he received the stab wound, about 20 years ago there had been no abnormality of the skin of the nose, as far as the patient is aware. After this injury, the wound would partly close, only to break down again The granulating area would become covered with a scab, but when the scab separated and was shed, the underlying surface became ulcerated once more Thus, an alternating of a feeble attempt of surface restoration and open ulceration has been going on for many years, with frequent episodes of bleeding from the nose

Together with the chronic ulceration of the nasal dorsum there developed a moderate enlargement of the lower segment of the nose of the nature of a rhinophyma Just when this latter condition began is not altogether certain but the patient is sure that there was nothing of this sort evident before the injury and the development of ulceration

Since the injury, there has been treatment from time to time, at various clinics, with the use of a variety of external applications and there is also a history of a few X-ray treatments, of which no further information has been obtainable A prothesis to mask the ulcerated area was worn at one time for a while, but it was found to be very awkward and difficult to keep in position, so it was abandoned

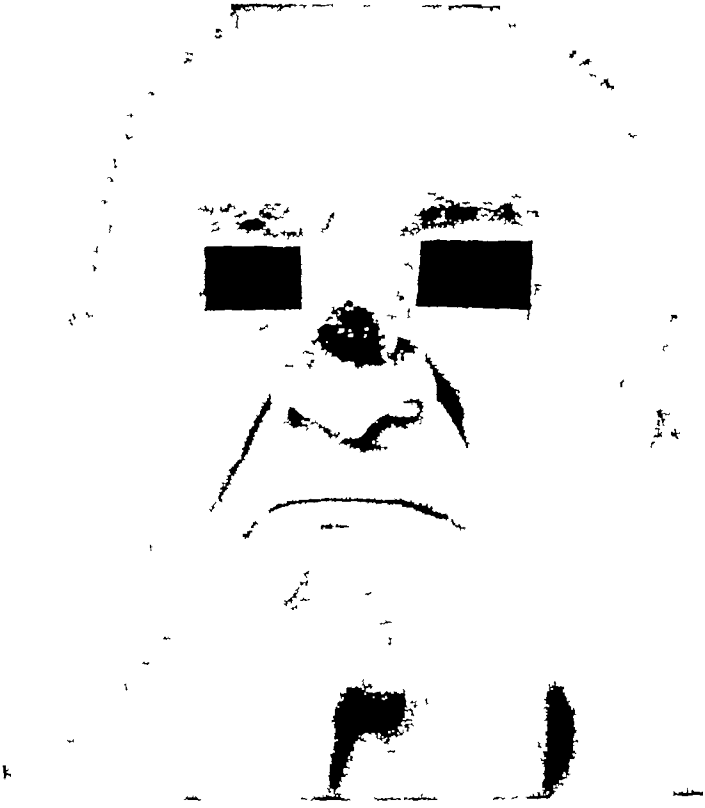

Fig 1A

When the patient was first examined by the writer recently, the nose was enlarged, and over the junction of the bony and cartilaginous septums was an open ulcerating area of irregular outline, roughly 1 cm. in its anteroposterior diameter, by 2.5 cm. laterally, extending well down over the left side of the nose and encroaching upon the ala (see Figs. 1A and 1B)

Fig 1B

A biopsy specimen was taken, the report on which confirmed the clinical diagnosis of epidermoid carcinoma (epithelioma) The histological report specified that the specimen consisted of fibrous tissue, extending downward into which were a number of rounded islands of epidermoid cells and in some of these cell masses there were characteristic keratin pearls

An X-ray examination was also made, with a report of normal appearing nasal and facial bones The frontal, ethmoid, sphenoid and right maxillary sinuses were all clear, but there was opacity of the entire left antrum Although the Roentgenologist considered that this condition was probably due to a chronic sinusitis, because of the diagnosis of the nasal ulcer as malignant, a Caldwell-Luc operation was performed upon the left maxillary sinus The tissue was submitted for a histological examination, and the report received gave the gross report of the specimen as small, thin, gray-white friable fragments of slightly roughened mucosa, and

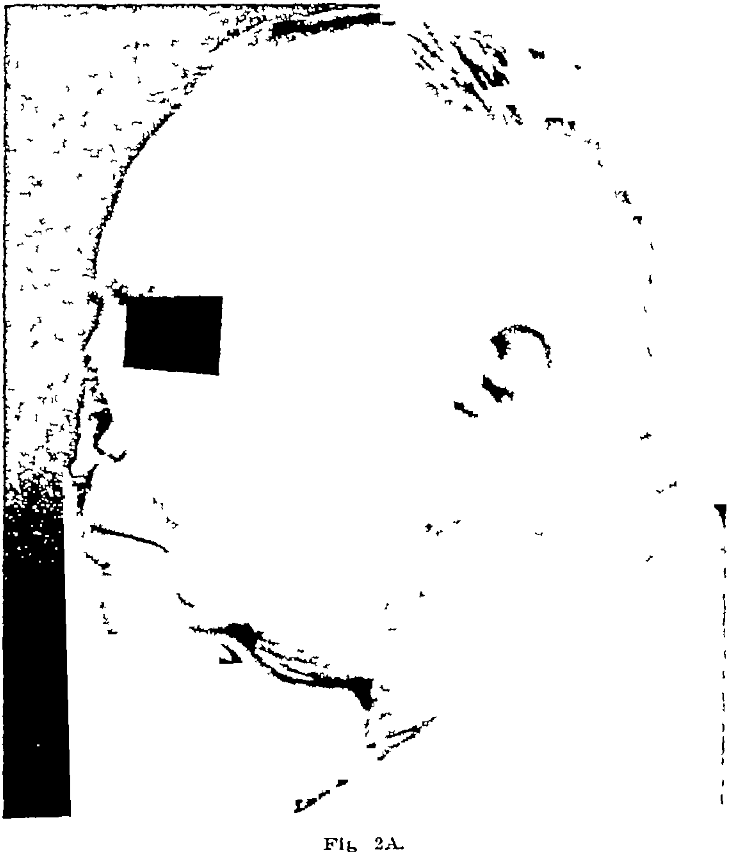

Fig 2A.

four rounded pieces of bone, about 5 mm in diameter, covered partly by mucosa. The report on both these specimens was entirely negative for malignant changes both in soft tissues and in bone.

An operation upon the nose was then planned and under general anesthesia (intravenous sodium pentothal) an extensive incision of the nose was made, with the electric cautery,

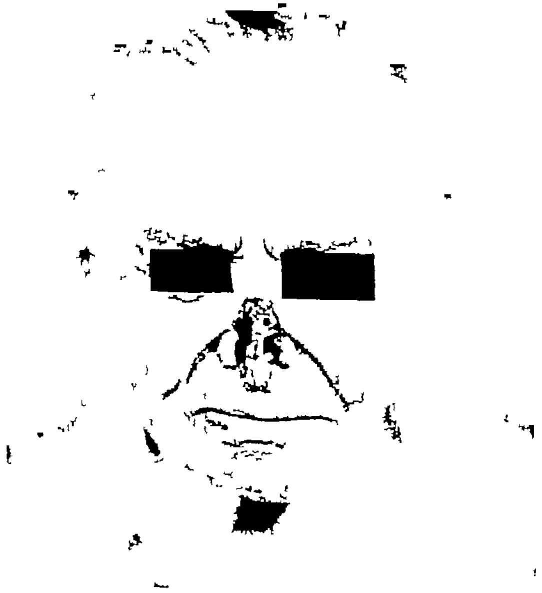

Fig 2B.

including the entire tip but excluding the alae and reaching well up over the bridge, to include all the malignant process (see Figs 2A and 2B) Bleeding was profuse but controllable

The excised specimen was sent for pathological examination, and was reported to have a sufficiently wide, malignant-free border

The patient made an excellent recovery, with the loss of only two weeks of working time After the operative wound is entirely healed, a period of six months or more, a nasal reconstruction will be done, using a forehead flap Meantime, a bandage is worn over the defect in the nose, and is proving quite satisfactory

SUMMARY

A case is described of a prison guard, who received a stab wound of the nose 20 years ago, which was followed only recently by the development of rhinophyma and malignant new growth

The lower segment of the nose has now been amputated, to include all abnormal tissue, and a reconstruction will be done after healing is complete, using a forehead flap

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THE TREATMENT OF NASAL POLYP BY THE RUSKIN METHOD *

JUAN JIMENEZ CERVANTES, M D ,
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In THE LARYNGOSCOPE (Vol LX, No 1, 1950) we find a report published by Ruskin on the treatment of nasal polyp by means of intrasinual injections or instillations of penicillin procaine.

Ruskin used this treatment in an almost fatal recurrence of polyp after its surgical removal, although, as Halle and Hajek advocate, the extirpation was done radically and the ethmoid totally emptied. Later, this treatment was modified as regarding the influence of allergy on the production of polyp was recognized

The nasal polyp is described as a continuation of the sinus mucosa grossly distended by the accumulation of transudate. The larger production of the latter in comparison with its reabsorption speed gives rise to its continuous growth, therefore, the keystone of the treatment is this to increase reabsorption rather than to promote transudate. In order to attain this condition reduction of the allergic activity and control of infection must be obtained

We will point out briefly the fundamental management Penicillin procaine salt is stable and does not produce hydrolysis. Due to the small absorption capacity of the sinus mucosa an action of deposit is produced within the sinus so that the anti infectious action is at its maximum. Another very important factor is the antihistaminic action of procaine

Ruskin used anti infectious and antihistaminic treatment in 60 cases of nasal polyposis with excellent success He

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introduced penicillin-procaine into the sinus by means of a modified Yankauer cannula on three consecutive days, then on three alternate days, and finally once a week for two weeks, the nose remaining free from polyps

The description of this simple and highly successful procedure with its seemingly logical basis led us to use this treatment on eight patients (six adults and two children) and the result was absolutely nil I lowered and increased the concentrations with the same result I do not believe the failure to be due to my introduction of the drug by puncture, because by this means and by injecting penicillin alone it was possible to cure a patient suffering from a purulent maxillar sinusitis accompanied by a single polypoid formation, of brilliant red color, similar to a huge inflammatory edema, as usually seen on the uvula or the posterior pillar in peritonsillar abscesses or in the arytenoids in some forms of laryngeal tuberculosis This polypoid formation disappeared at the first injection of penicillin into the sinus, and the sinusitis (monosinusitis, which precludes allergy) was cured after four more punctures There has been no recurrence in three years

CONCLUSIONS

From our experience in the treatment of eight cases of nasal polyposis, we conclude

1 The injections of penicillin-procaine into the sinus do not cause the disappearance of the polyps in the middle meatus, when it is a true polyp

2 Amelioration and even disappearance of inflammatory edema localized in the middle meatus, and following a more or less acute sinusitis, is possible

3 This was deduced from the results obtained by injecting antibiotics in the treatment of sinusitis In those cases with a strong chronic hyperplasis of the mucosa the utmost result was sometimes temporary sterilization, while in the acute or subacute cases with medium or even strongly increased mucosa, the return to normality is immediate

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SYMPOSIUM

SURGICAL TREATMENT OF HYDROPS OF THE LABYRINTH

(a)—SURGICAL DESTRUCTION OF THE LABYRINTH FOR MENIERE S DISEASE *

KENNETH M DAY M D,
Pittsburgh, Pa

Ménière's disease or endolymphatic hydrops is a distinct pathologic and clinical entity characterized by a distention of the endolymphatic labyrinth. It is generally accepted that this disorder is caused by an autonomic dysfunction affecting the capillary loops of the stria vascularis

It cannot be stressed too strongly that Menière's syndrome and Ménière's disease are not synonymous There is a prevalent tendency among physicians to make a diagnosis of Ménière's disease in all cases having labyrinthine vertigo of uncertain origin whether or not there is an associated deafness and tinnitus An analysis of the cochlear symptoms usually is neglected even though it is by this means that one can make an accurate and sure diagnosis, in fact, a diagnosis of Menière s disease should be made from the cochlear symptoms alone, and if this be done and treatment instituted early, the hydropic condition often can be controlled and vestibular involvement presented This is of considerable impor-

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*Read as part of a Symposium at the Fifty sixth Annual Meeting of the American Laryngological Rhinological and Otological Society Inc. Toronto Ontario, May 1, 1952.

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tance since signs of cochlear distention often will precede the vestibular signs by months or years In a review of 220 case histories reported by me[3] two years ago there were only five cases with a history of attacks of vertigo preceding the onset of hearing disturbances

Spasm of the utricular branch of the internal auditory artery might cause acute vertiginous attacks, but I question whether changes in the volume of endolymph would occur as a result of this reaction I have yet to recognize a case of this type with acute attacks of vertigo and no cochlear symptoms which on subsequent examination has shown the appearance of cochlear symptoms This is contrary to Dandy's report of cases of what he called pseudo-Menière's disease, because no deafness or tinnitus were present That an occasional case of this type might occur, I do not deny, but I believe it must be rare

The inability of conservative treatment to relieve or control the symptoms of Meniere's disease in many cases makes consideration of surgical intervention necessary As a general rule the longer the duration of symptoms and the greater the endolymphatic distention the less effective will be conservative treatment The surgical procedures under consideration in this symposium include surgical destruction of the labyrinth, partial or total section of the VIIIth cranial nerve and surgical drainage or ablation of the endolymphatic sac

My own personal experience is limited to surgery of the labyrinth I have not attempted to operate upon the endolymphatic sac because of the frequency of recurrence of symptoms in cases operated upon by some of my confreres It was because of dissatisfaction over the results of nerve section that George Wright, who was Professor of Neurology at the University of Pittsburgh, suggested to me, in 1939, that surgery of the labyrinth should be given a trial for Menière's disease In view of the pathologic findings of an endolymphatic distention of the labyrinth, as reported by Hallpike and Cairns[6] in the preceding year, this seemed to be the logical point of attack

Imbued with the idea of trying to destroy the vestibular mechanism without sacrificing hearing, I attempted to do a differential electrocoagulation of the vestibular contents without destroying the saccule or damaging the cochlea. I was successful in preserving cochlear function in 16 of the first 54 cases upon which I operated (see Fig 1) This may sound like a fine achievement but actually, these patients were none too happy over the results Four cases had a recurrence of vertigo, including two in which hearing had been preserved

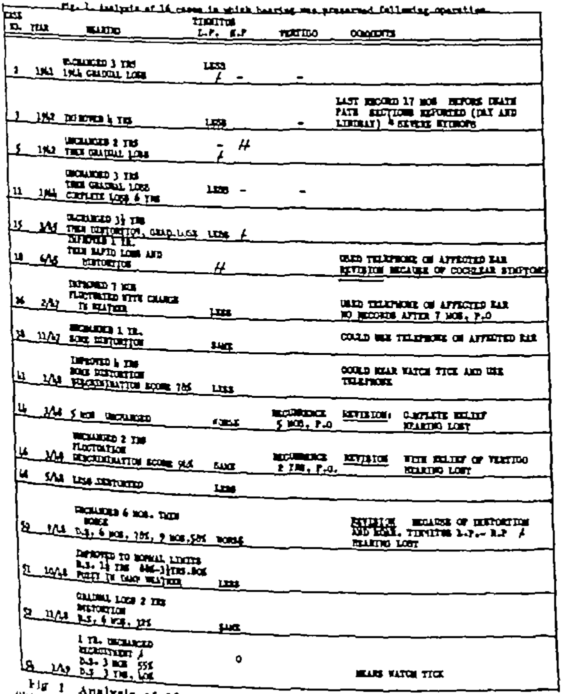

Fig. 1. Analysis of 16 cases in which hearing was preserved following operation

CASE NO.	YEAR	HEARING	TINNITUS L.P.	TINNITUS H.P	VERTIGO	COMMENTS
2	1941	UNCHANGED 3 YRS 1944 GRADUAL LOSS	LESS +	-	-	
3	1942	IMPROVED ½ YRS	LESS		-	LAST RECORD 17 MOS BEFORE DEATH PATH SECTIONS REPORTED (DAY AND LINDSAY) = SEVERE HYDROPS
5	1942	UNCHANGED 2 YRS THEN GRADUAL LOSS	- +	++		
11	1944	UNCHANGED 3 YRS THEN GRADUAL LOSS COMPLETE LOSS 6 YRS	LESS	-	-	
15	3/45	UNCHANGED 3½ YRS THEN DISTORTION, GRAD.LOSS	LESS	+		
18	6/45	IMPROVED 1 YR. THEN RAPID LOSS AND DISTORTION	++			USED TELEPHONE ON AFFECTED EAR REVISION BECAUSE OF COCHLEAR SYMPTOMS
26	2/47	IMPROVED 7 MOS FLUCTUATED WITH CHANGE IN WEATHER	LESS			USED TELEPHONE ON AFFECTED EAR NO RECORDS AFTER 7 MOS, P.O
38	11/47	UNCHANGED 1 YR. SOME DISTORTION	SAME			COULD USE TELEPHONE ON AFFECTED EAR
41	2/48	IMPROVED ½ YRS SOME DISTORTION DISCRIMINATION SCORE 78%	LESS			COULD HEAR WATCH TICK AND USE TELEPHONE
44	3/48	5 MOS UNCHANGED	SAME		RECURRENCE 5 MOS, P.O	REVISION: COMPLETE RELIEF HEARING LOST
46	3/48	UNCHANGED 2 YRS FLUCTUATION DISCRIMINATION SCORE 96%	SAME		RECURRENCE 2 YRS, P.O.	REVISION WITH RELIEF OF VERTIGO HEARING LOST
46	5/48	LESS DISTORTED	LESS			
52	9/48	UNCHANGED 6 MOS. THEN WORSE D.S. 6 MOS, 70%, 9 MOS, 58%	WORSE			REVISION BECAUSE OF DISTORTION AND NOISE. TINNITUS L.P.- H.P + HEARING LOST
51	10/48	IMPROVED TO NORMAL LIMITS D.S. 1½ YRS 84%-3½YRS.80% WORSE IN DAMP WEATHER	LESS			
52	11/48	GRADUAL LOSS 2 YRS DISTORTION D.S. 6 MOS, 92%	SAME			
58	1/49	1 YR. UNCHANGED RECRUITMENT + D.S. 3 MOS 55% D.S. 3 YRS, 10%	0			HEARS WATCH TICK

Fig 1 Analysis of 16 cases in which hearing was preserved following operation.

evidently due to incomplete destruction of the vestibular labyrinth Revisions to complete the destruction were done successfully in these four cases Revisions were done also on two other cases because of continued roaring tinnitus and distorted hearing, although they already were completely free of vertigo In only four cases could I demonstrate practical hearing for speech maintained for more than two years following operation The majority of cases continued to have loud, roaring tinnitus and distortion of hearing with deafness gradually increasing over a period of years

It finally dawned upon me that I was really doing these patients a disservice by attempting to preserve the hearing of the affected ear It was largely as a result of the follow-up study of this series of cases that I reached a full appreciation of the significance and severity of the cochlear symptoms of Meniere's disease Whether hearing is preserved by differential nerve section or differential electrocoagulation the result should be the same There remains a distended cochlear duct with its associated disagreeable symptoms of diplacusis, distortion and roaring tinnitus The exception to this rule will be the occasional case with improved hearing and subsidence of symptoms due to the shock effect of surgery causing a correction of the autonomic dysfunction and a remission of symptoms which may be temporary or permanent This would be analogous to the occasional effect of such surgery as tonsillectomy upon hay fever or vasomotor rhinitis I hope that during this symposium we may hear more about the actual hearing ability of the affected ear following differential nerve section or ablation of the endolymphatic sac Pure tone audiometry does not give this information The difficulty in understanding speech is out of all proportion to the threshold hearing loss Discrimination scores will show this clearly (see Fig 2) The combination of roaring tinnitus, distortion of hearing and severe recruitment results in extremely poor ability to understand conversational speech

I abandoned the procedure of differential electrocoagulation three and one-half years ago and now do a labyrinthectomy with destruction of both the cochlear and vestibular mechan-

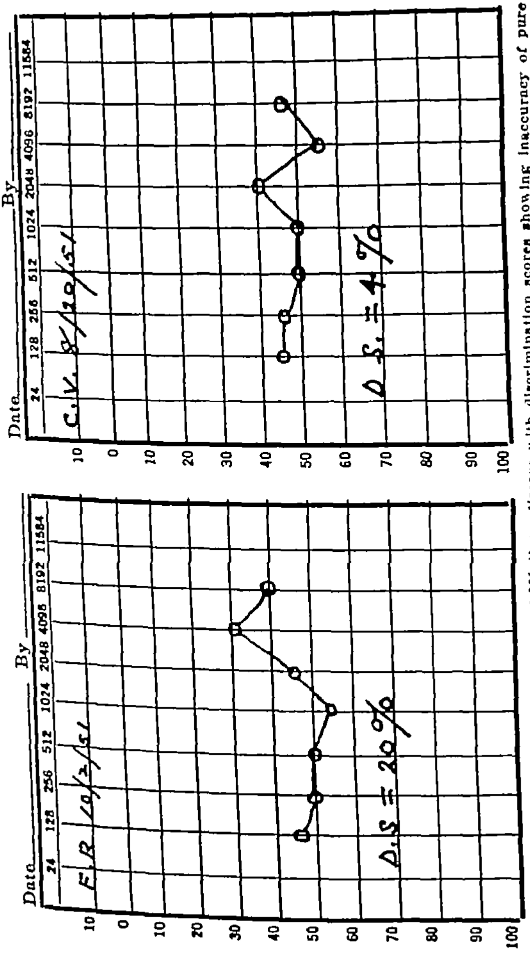

Fig Typical audiograms of two cases of Ménière's disease with discrimination scores showing inaccuracy of pure tone audiometry as an index of ability to understand speech isms The labyrinth can be destroyed effectively by the Cawthorne method of removing the membranous horizontal semicircular canal or by passing a barbed dental broach or fine curette into the vestibule to remove its contents I, personally, use a dental broach followed by a needle electrode to coagulate the sensory nerve endings in the vestibule, because I believe that this procedure insures a smoother and shorter period of convalescence I do not advise the employment of the needle electrode by the inexperienced surgeon, as there have been several reports of facial paralysis occurring after its improper usage The membranous labyrinth is not as delicate an organ as one would expect Unless a portion of it is actually removed at operation there is a possibility of residual function persisting after operation The continuation or return of roaring, low-pitched tinnitus following operation is indicative of incomplete cochlear destruction Recurrence of dizzy spells suggests incomplete vestibular destruction and a revision is indicated

If one labyrinth is completely destroyed the question will immediately arise as to the danger of involvement of the other ear Fortunately, this occurs but rarely It is true that Meniere's disease may involve both ears in about 10 per cent of the cases but, when this does happen, both ears are usually affected simultaneously Of the 220 case histories which I analyzed two years ago[3] there were 27 cases of bilateral involvement, but in all but four instances the involvement of both ears occurred simultaneously In the series of cases upon which I have operated to date there has been only one instance of subsequent involvement of the unaffected ear In this case the symptoms were confined to the cochlea with hearing loss, low-pitched tinnitus and distortion Under prompt conservative treatment the symptoms disappeared, and the hearing returned to normal and has remained so for the past year In bilaterally affected cases surgery seems to be contraindicated If other conservative measures fail to control the condition, streptomycin therapy should be considered

I have gone into considerable detail about the undesirability of preserving cochlear function because the advocates of differential nerve section use the preservation of cochlear function as their main argument in claiming nerve section to be the operation of choice for Menière's disease Aside from the questionable desirability of preserving hearing in the affected ear the nerve section operation has little to offer in its favor It seems illogical to perform an intracranial operation which entails the opening of the arachnoid space when the peripheral organ can be attacked more easily and with greater safety Surgery of the VIIIth nerve is a major undertaking with a significant mortality rate aside from Dandy's unequaled record. Complications and undesirable side effects are not uncommon, especially damage to adjacent cranial nerves Little discussion has been given of these factors in the literature In Dandy's[2] report to the American College of Surgeons, he concluded "I know that (the) operation cures the disease with almost no risk and with no side effects" Yet, in a recent report of Dandy's series, Green and Douglas state that the most important complication was facial paralysis, of 408 cases undergoing partial or complete nerve section, 54, or 13 2 per cent, developed facial paralysis which remained complete in over 4 per cent, in fact, with complete section facial paralysis occurred in 25 per cent. Dandy himself admitted that approximately 10 per cent of his cases showed recurrences when partial nerve section was performed This is to be expected since pathologic studies by Rasmussen[6] have shown that as much as one-fifth of the cochlear nerve may be occupied by vestibular fibres Putnam[7] stated that the procedure of VIIIth nerve section is not always as easy rapid and safe as some accounts would lead us to believe and he attempted a simpler procedure by exposing the superior semicircular canal through a subtemporal decompression Through a trephine opening into the canal he passed a needle and coagulated the vestibular contents with indifferent success

In deciding the operation of choice for Menière's disease, the following questions need an answer

1 The effectiveness of the procedure in terminating or relieving the symptoms

2. The surgical risks involved
3. The frequency of complications and unfavorable side reactions
4. The simplicity of the procedure
5. The length of time required for recovery and rehabilitation

My answers are

1. Labyrinthectomy is completely effective in terminating the attacks of vertigo in unilateral Meniere's disease It also relieves distressing cochlear symptoms at the expense of destroying hearing which already is of little or no use
2. Surgical risks are minimal with labyrinth surgery I have heard of only one fatality from a brain abscess
3. The only complications in my series of 94 operations were two simple hematomas, one of which required evacuation Cawthorne[1] reported 159 operations with two postoperative infections as the only complications in his series
4. Labyrinthectomy by way of a mastoid antrotomy, using either an endaural or postauricular approach, is a relatively simple procedure with a minimum of surgical shock The operation can be completed comfortably in 30 minutes I have operated several cases over 70 years of age and one case over 80
5. Hospitalization usually is limited to seven or eight days and the average case is back to work within three weeks following labyrinthectomy

For the above reasons labyrinthectomy is the operation of choice for this condition

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SYMPOSIUM

SURGICAL TREATMENT OF HYDROPS OF THE LABYRINTH

(b) — THE PORTMANN OPERATION*

MR. ROBERT L. FLETT (by invitation),
Derby, England

In 1927, Portmann advocated opening the saccus endolymphaticus for Meniere's disease and claimed good results from this. At this time Guild also described the saccus, dividing into three parts: proximal, intermediate and distal, the intermediate part being surrounded by connective tissue. In a later paper he related his discovery, using the Prussian blue technique, that endolymph was absorbed in that area. In 1938, Hallpike described the microscopical appearances of the membranous labyrinth and saccus in Meniere's disease and suggested that the changes might be due to lessened absorption of endolymph in the intermediate part. Woodman and Stirk Adams, in 1939, reported 10 cases in which they had performed the Portmann operation, nine of them with striking results.

I became more interested in this method of treatment when, in 1939, a miner reported with very severe symptoms of giddiness and deafness in his left ear, the only good ear. In 1908, his right ear had undergone a very radical mastoid operation for lateral sinus thrombosis and ligature of the internal jugular vein, and the result was total facial paralysis and total labyrinthine deafness. All investigations regarding Eustachian obstruction, sinusitis, water and salt metabolism, etc., were negative, and during this time of waiting he became very impatient. He worked on the coal face, and every time

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he had an attack he had to be carried to the pit bottom, and during this journey of two miles his mates remarks often became somewhat cutting They had already carried him six times and swore they would not do it again He wondered if some operation could be done without deafening his left ear any further I, therefore, admitted him to the hospital without delay and performed the Portmann operation The result was most striking as soon as he recovered from the anesthetic, the giddiness and tinnitus had disappeared and the hearing was almost normal through the bandages. To me, this was too good to be true, however I saw him two months ago and the condition of his left ear was normal Since then I have had to do this in 60 cases This may seem rather wholesale, but not out of a hospital population of half a million with a conservative estimate of 150 cases of aural vertigo per year Prewar there was a smaller number of cases, but they seemed to be more severe than those we are seeing now We carried out routine investigations and treatment and these 61 cases are those which showed no response and which were so severe that something must be done indeed, apart from the case quoted, and one other I was prepared to proceed to labyrinthine destruction

The other case was similar to the first. The right ear was totally deaf due to a labyrinthitis during diphtheria in childhood Then in 1941, a left Portmann operation was performed with immediate restoration to normal Three years later the symptoms recurred and the patient demanded that the operation be redone Again she improved just as much but recurrence took place one year later Operation for the third time then produced no change

The operation is performed through the postaural mastoid incision and the mastoid opened in order to expose the lateral sinus. By blunt dissector and fine curette, the cerebellar dura medial to this is lifted from the posterior surface of the temporal bone On the average skull the distance from the lateral sinus to the saccus is about 1 cm but it may be necessary to go medially for 1 5 cm This should not be exceeded as the internal auditory meatus is only 2 cm away Lately

I have been accustomed to work through a small opening in the lateral sinus plate and to take away bone from behind the posterior semicircular canal This, I think, makes it more certain that the saccus under its shelf of bone will be opened It is seldom seen, and sometimes the dura is opened at that point At times the hemorrhage is so brisk from emissary veins that the wound may require packing for two days before proceeding further The mastoid antrum is opened and the bony external semicircular canal exposed, in case labyrinth destruction is required The wound is sutured with no drain Any case that shows no immediate improvement is reopened in one week's time and the labyrinth destroyed

RESULTS – 61 PATIENTS

Postoperative deaths, two *1* Meningitis *2* Bronchopneumonia

Immediate failures, eight Destruction of labyrinth one week later

One wrong diagnosis Epileptic aura (this diagnosis was made after six years)

Fourteen cases with perfect result

Thirty-six cases with some improvment

36 CASES WITH SOME IMPROVEMENT

Giddiness Disappeared, 21, improved, 12, no improvement, three

Tinnitus None, 11, slight or used to it, seven, colds cause buzzing, two, bad, eight

Deafness Normal hearing, six, no improvement or worse, 30 — 50 to 70 db loss, and of these, nine have hearing aids

The results can be seen in Table I There were 61 cases in 10 years up to June, 1949, and two and one-half years have been allowed for follow-up from then, 26 cases occurred on the right side and 35 on the left

The operation is not without danger as there were two postoperative deaths one from meningitis — streptococcal in type, in a case that had to be opened twice, owing to hemorrhage the first time the second case died of bronchopneumonia five days after the operation There were eight immediate failures, and these required destruction of the labyrinth one week later There was one which I may term a wrong diagnosis she was not improved at all, and it took us and the neurological physicians six years to decide that this was due to an epileptic aura of the *petit mal* type There were 14 cases with a perfect result, that is, the hearing showing only 10 db loss over the speech range with slightly increased higher tone loss The remaining 36 cases showed some improvement. I shall now analyze these 36 cases

Giddiness Disappeared in 21, improved in 12, and showed no improvement in three, and really these three cases should have their labyrinths destroyed The tinnitus had disappeared in 11, seven cases complained of slight tinnitus or had become accustomed to it, colds caused buzzing in two, and eight complained of severe tinnitus, as, for example like a bomb whistling down. Heavy work, especially moving the right arm, causes the palpitation to go to the right ear I also saw two cases where the tinnitus was almost unbearable I have had some of these show delay in improvement in the noises, or noises may come on again in three months' time and may later, for no apparent reason, disappear

Hearing Six of these cases showed hearing loss up to 10 db over the speech range and I have designated these as normal The remaining 30 show no improvement or have become worse, that is, 50 to 70 db loss and of these, nine have hearing aids. I shall further discuss the giddiness in those cases which have improved

1 Complained of slight giddiness in 1950, 10 years after the operation, but before the operation he had severe giddiness with vomiting and diarrhea and has not been absent from work since

2 Had two attacks in 10 years, was off work once for five weeks and another time for two weeks

3 Complained of slight giddiness with colds, but could carry on his work

4 Becomes slightly lightheaded with noises at times

5 Eight years after the operation had one attack of giddiness He was operated upon at the age of 15

6 Is aged 71 and complains of slight giddiness when doing too much work, especially with the arm upward

7 Had one short attack eight years later, but none since

8 Has been off work one month, eight years after the operation, but the attack was much less severe

9 Complained of slight giddiness on turning over in bed or stooping suddenly

10 Is a miner who complains of slight giddiness on walking in the dark, especially in the coal pit

11 Three years after the operation complained of slight giddiness

12 Complained of a feeling of general swimminess with no bouts of giddiness

In these cases there was sometimes a delay in improvement up to one year and, indeed, two of them during this time were put on the waiting list for destruction of the labyrinth, but later reported, saying that they did not wish to have the operation as they were much better

The giddiness has been investigated by caloric test in only one This was a patient who had had a good result and she was so upset to find that she could become giddy again that, notwithstanding my explanations of this, she continued giddy for another two months, and I have, therefore, not performed it on any of the other patients

Except for 11 patients, the results concerning giddiness, show that there is still some place for the Portmann operation, however, it may be argued that with the deafness now up to 50 to 70 db loss in 30 of these patients, the progress regarding giddiness is somewhat like the normal progress of Menière's disease without treatment, i e, normal progress cut short, and also that no definite benefit has been obtained Even if this is the case there are only three cases which show severe giddiness in attacks, and as can be seen from the 12 cases that have been considered as only improved, all of these have been able to continue with their work over periods of years without interruption

I have performed no destruction of the labyrinth since 1947

SYMPOSIUM

SURGICAL TREATMENT OF HYDROPS OF THE LABYRINTH

(c) — THE RESIDUAL HEARING FOLLOWING PARTIAL RESECTION OF THE VIIIth NERVE*

K G McKenzie, M D (by invitation),
Toronto, Ontario

It is my hope that a follow-up report on patients submitted to intracranial section of the vestibular nerve at the Toronto General Hospital will be of interest and value in this symposium on “Hydrops of the Internal Ear ” The follow-up has been carried out by Dr Barber and Dr Ireland, and they will submit their findings in the next paper My following brief remarks may be looked upon as an introduction to their factual paper

To begin with, my interest in this subject goes back many years I recall clearly the time in 1930 when McGregor and I obtained a fresh autopsy specimen of the petrous bone with the intracranial VIIIth nerve intact We took this to a dentist's office and, using his drill and good light, we spent several satisfactory hours laying bare the nerve in the canal up to the internal ear In this situation the nerve could be seen in two distinct portions one vestibular and the other cochlear By gross dissection we could separate the nerve down to its intracranial portion Just internal to the internal auditory meatus it was obvious that the vestibular nerve was the most superficial half of the VIIIth nerve The cochlear portion was deepest and the facial nerve was in close approximation to the deepest or cochlear portion This relationship is of some interest to surgeons, because the vestibular portion can be

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split off at the internal meatus and cut without disturbing the facial nerve, in fact, there is much less chance of traumatizing the facial nerve by cutting only the vestibular portion than there is by section of the whole nerve In all, Dr Botterell and I have cut the vestibular nerve intracranially in some 117 patients and temporary facial paralysis has been a complication in only one case

Another observation that Dr McGregor and I made on the specimen interested us greatly Microscopic study of the vestibular and cochlear nerves showed that they had quite a different appearance The vestibular fibres were much larger and coarser than the cochlear fibres Just medial to the internal auditory meatus where the surgeon splits off the vestibular portion there was some mingling of fibres Obviously in this specimen if the nerve is not split approximately in its middle the most easily accessible half would consist almost entirely of vestibular fibres At that time we could find no reference in anatomical or histological texts describing this microscopic difference in two halves of the VIIIth nerve It was such a simple observation that I am sure others had noted it before, and it does not seem possible that it could have been original with McGregor and myself Since then Rasmussen (THE LARYNGOSCOPE Vol 50, pp 67 83 1940) has confirmed the observation. I would appreciate information from any member of this audience on any earlier observations on this point Our findings were reported and filed in the *Transactions of the Toronto Academy* in 1932, where we also recorded the first cases operated upon by section of the vestibular nerve, leaving the cochlear portion intact All this is a matter of local background, and I thought it might interest you

Through the years I have operated upon a large number of cases, and on the whole the patients were grateful and well-pleased with the results As the years went on and more was known about the disease and its natural course, I found myself operating upon a smaller percentage of patients It was possible to have a frank talk with many and persuade them to accept a few severe spinning attacks a year with equanimity They were prepared to do this when told firmly that the symptom did not indicate the presence or development of any serious disease or growth, the attacks, although alarming, would never endanger their lives, the disease usually ran an up and down course with periods of freedom from attacks for months at a time and, in the end, over a variable period of years, would probably cease It was made clear that the operation could be done at any time if they were the unusual case that had sufficient attacks to make life altogether miserable and economically unsound Finally, they were informed that no medicine or special diet was of any value It always seemed to me that the sound psychological handling of such a patient is weakened by prescribing medicine, as the patient could then justifiably feel that the right doctor and right medicine would stop the attacks, and commence wandering from doctor to doctor, in danger of becoming emotionally upset and ceasing to be a productive citizen I did have a few patients put on a rigid salt-free diet but finally concluded that the diet was worse than the disease, particularly as I could not satisfy myself that it was of any real value in lessening attacks

This gradually increasing conservative viewpoint has resulted in fewer operations on patients with Meniere's syndrome on the neurosurgical service at the Toronto General Hospital during recent years I realize, however, that there is another reason for fewer operations by the intracranial approach My colleagues, the otologists, have now largely taken over the surgical treatment of the disease with their operation of destruction of the labyrinth I have not had sufficient experience with this operation to compare it satisfactorily to the intracranial procedure Mortality should be minimal in both procedures, we have had two deaths in 117 cases I know of one death in this Center from cerebellar brain abscess secondary to destruction of the labyrinth I believe you will agree after reading the paper by Dr Ireland and Dr Barber that our results from the standpoint of cure of attacks have on the whole been very satisfactory Preservation of useful conversational hearing for long periods of years in patients with good hearing before operation has been worthwhile Intracranial vestibular section would definitely be the operation of choice in a patient deaf from middle ear disease or some other cause in the unaffected ear

I would caution otologists and physicians to adopt a conservative approach. Adequate and straightforward advice will enable many of these patients to accept their attacks with equanimity Not too many require surgical treatment

Are you in this group really prepared to accept the pathological evidence that these patients have edema of the internal ear? I have some nostalgic feeling regarding the term Ménière's syndrome being replaced by 'hydrops of the internal ear' Menière's syndrome has meant a good deal in a clinical way through the years and the term "hydrop" will, I believe, require modification when more is known about this disease which causes severe spinning attacks and typically is associated with noise in one ear and some progressive deafness most marked in that ear in which the noise is heard by the patient. The disease cannot be entirely confined to the internal ear, if this were true, complete section of the VIIIth nerve would stop the noise in the ear We know that this happens in only a few cases

Finally, speaking as a neurosurgeon, I wish my otologist colleagues good luck with their operation of destruction of the labyrinth Long term follow up of the results in this operation will be needed for satisfactory comparison with intracranial section of the vestibular nerve,—an operation that has remained highly satisfactory in properly selected cases over a period of some 20 years

Medical Arts Building

SYMPOSIUM

SURGICAL TREATMENT OF HYDROPS OF THE LABYRINTH

(d) — THE CLINICAL RESULTS FOLLOWING DIFFERENTIAL SECTION OF THE VIIIth NERVE *†

H O Barber, M D § (by invitation),
and
P E Ireland, M D,
Toronto, Canada

The original complete section of the VIIIth nerve by the intracranial route, as introduced by Dandy,[1] was a distinct advance in the relief of the symptoms of labyrinthine hydrops An attempt to improve this procedure was first made by McKenzie,[2] of Toronto, by the differential section of the vestibular fibres at their exit from the internal auditory meatus This report concerns a review of available cases which were operated upon by this method during the 20 years from 1931 to 1951 During this time, 117 patients were operated upon by the neurosurgical service of the Toronto General Hospital, with close cooperation from the department of otolaryngology in the clinical assessment In this group of cases, two died in the immediate postoperative period and five have died subsequently of unrelated causes There were also seven patients who, for various reasons, had complete section of the VIIIth nerve With this exclusion, there remain 103 patients with section of the vestibular portion of the VIIIth nerve, of whom 53 have returned for re-examination during 1951 and 1952

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*Read as part of a Symposium at the Fifty sixth Annual Meeting of the American Laryngological Rhinological and Otological Society Inc., Toronto Ontario May 21 1952

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The purpose of this paper is to report on the long-term, clinical progress of these patients The follow-up examination has been conducted with the purpose of tracing the course of the main triad of characteristic symptoms of this disease, but with particular reference to the residual hearing which has been retained

In reviewing each patient, a careful interim history was taken. The hearing was tested by a pure tone audiometer usually the Maico E 2 type The audiograms obtained were arbitrarily divided into three groups, namely

1 "Useful hearing"—with average loss in frequencies 500 to 2,000 c.p.s. (inclusive) of less than 50 db

2 "Borderline hearing"—with average loss in frequencies 500 to 2,000 c p s (inclusive) of 50 to 55 db

3 "Hearing of no value"—with average loss in frequencies 500 to 2,000 c.p.s (inclusive) of greater than 60 db

In addition to this, all patients with "useful" or "borderline" hearing were examined by recorded speech and masked conversational voice This was done in an attempt to determine if any discrepancy existed between the speech reception threshold (SRT) and reception of pure tones

The technique adopted for testing labyrinthine function was that of massive caloric stimulation with water at 50° F A labyrinth was considered dead if no response resulted from five minutes' stimulation by this method.

It was also considered that the subjective opinion of the patient on whom intracranial section had been performed might be of importance both from the standpoints of hearing and relief of the original symptoms In this regard a detailed history was taken as to relief of vertigo and tinnitus and also the ability to continue in a normal vocation.

TABLE 1

DIFFERENTIAL SECTION VIIIth NERVE

Total number of patients considered	103
Sex	
Male	73
Female	30
Age when operation performed	
Youngest	19 years
Oldest	64 years
Mean	46 9 years

From this investigation, it is apparent that hydrops of the labyrinth is largely a disease of middle age The predominance of males over females might be explained on an economic basis This indicates only that the question of the need for surgical intervention is decided mainly on the ability of the individual to continue in his useful sphere in life The problem naturally occurs more frequently in the breadwinner

TABLE 2

Group I (10 to 20 years follow up)	16 patients
Group II (5 to 10 years follow up)	19 patients
Group III (0 to 5 years follow up)	18 patients
Total	53 patients
Shortest follow up	3 months
Longest follow up	20 years
Mean follow up	7 70 years

From this table, it will be seen that the 53 patients who were examined have been divided into three groups which depend on the period elapsed since the operation was performed These are shown at this time only because they have significance in a later consideration of our findings

TRIAD OF SYMPTOMS

A—VERTIGO

TABLE 3

DIFFERENTIAL SECTION VIIIth NERVE
VERTIGO

Totally relieved (44 patients)	83.0 per cent
Partially relieved (two patients)	3.8 per cent
Not relieved (seven patients)	13.3 per cent

The relief of this symptom has presented one of the most controversial subjects in any surgical procedure for hydrops of the labyrinth. The figure (87.7 per cent) presented by Green and Douglass[3] on Dandy's cases is in essential agreement with our own.

Referring again to Table 3, it is seen that seven patients (13.2 per cent) were not relieved. Of this number, four had developed involvement of the unoperated ear, after a period of freedom from vertigo lasting from two to 16 years, with a mean average of 9.7 years. One failure was due to inadequate division of the vestibular fibres as indicated by an active caloric response at the time of survey. The remaining two patients had been incorrectly assessed preoperatively and were eventually disabled by psychogenic illness.

Two patients were only partially relieved, one stated that his attacks were much less severe and the other was found to have severe cardiovascular pulmonary disease to which his residual symptoms were attributed.

TABLE 4.
DIFFERENTIAL SECTION VIIIth NERVE
TINNITUS

Number of patients examined		53
Tinnitus absent (four patients)	7.6 per cent	41.5 per cent
Tinnitus improved (18 patients)	33.9 per cent	
Tinnitus unchanged (17 patients)	32.0 per cent	58.5 per cent
Tinnitus increased (14 patients)	26.5 per cent	

It may be seen from Table 4 that a very small number of patients were *completely relieved of this subjective symptom*. If we add a further group who stated that the tinnitus was improved, we obtain a more favorable figure (41.5 per cent), *comparable to that of Green and Douglass*[3] (36.9 per cent). The last two groups, in which the symptom was unchanged or increased, form a disappointing percentage of failures (58.5 per cent). In spite of this, one found, on questioning these individuals, that very few complained of their tinnitus. Almost invariably they had adjusted themselves to its presence and found it did not interfere with their daily routine. Two exceptions to this were individuals who had inadequate personalities.

TABLE 5
DIFFERENTIAL SECTION VIIIth NERVE
TINNITUS

Group I (10 to 20 years follow up—16 patients)	(a) absent	0
	(b) improved	6
	(c) unchanged	5
	(d) increased	5
Group II (5 to 10 years follow up—19 patients)	(a) absent	1
	(b) improved	4
	(c) unchanged	8
	(d) increased	6
Group III (0 to 5 years follow up—18 patients)	(a) absent	3
	(b) improved	8
	(c) unchanged	4
	(d) increased	3

It is evident from this grouping that the patients more recently operated upon (Group III) had the largest percentage of improvement and complete relief. In Group I (10 to 20 years' follow-up), no patients were completely relieved of the symptom. Of this group, three complained bitterly of noise, and all showed involvement of the other ear. Although *no explanation for these findings is available, it is possible* that they may be due to mere statistical chance.

C—HEARING

1 The Testing of Hearing by Pure Tone Audiometry

This method of examination was chosen because it provided a known standardization of hearing loss which could be compared with preoperative records

TABLE 6
DIFFERENTIAL SECTION VIIIth NERVE
RESIDUAL HEARING

Number of patients examined	53
Hearing useful (14 patients)	26 4 per cent
Hearing borderline (two patients)	3 8 per cent
Hearing of no value (37 patients)	69 8 per cent
CRITERIA USED	Useful—less than 50 db loss Borderline—50 to 55 db loss No value—over 60 db loss
TEST RANGE	50 to 2 000 c p.s. inclusive

From Table 6 it may be seen that an arbitrary figure of 50 db was chosen as the critical level for hearing loss by pure tones. This was used for various reasons, but chiefly because it was felt that at this level, either with or without a hearing aid, a patient could continue as a useful citizen even in the event of complete deafness in the other ear The test range selected was the commonly accepted conversational range of 500 to 2,000 c.p.s , inclusive.

TABLE 7
DIFFERENTIAL SECTION VIIIth NERVE
RESIDUAL HEARING

Group I (10 to 20 years—16 patients)	(a) useful	1
	(b) borderline	0
	(c) no value (3 bilateral)	15
Group II (5 to 10 years—19 patients)	(a) useful	4
	(b) borderline	2
	(c) no value (1 bilateral)	13
Group III (0 to 5 years—18 patients)	(a) useful	9
	(b) borderline	0
	(c) no value (1 bilateral)	9

Table 7 shows that the patients with retention of useful hearing fall largely into Group III (0 to 5 years' follow-up) This finding, coupled with the small number of patients with useful hearing in the longer follow-up periods (Groups II and I), indicates that deterioration does occur with the passing of years When the 10-year postoperative period has been reached, retention of useful hearing is very unlikely The only patient left with useful hearing in this group had had an incomplete operation, as indicated by an active response to caloric testing at time of survey

This long-term failure of hearing might well be explained by the progressive nature of the disease in the labyrinth It is most interesting that two patients had improved and useful levels of hearing by pure tone following the operation Both were completely relieved of vertigo, but both showed an active caloric response

2 *The Testing of Hearing by Recorded Speech Reception*

This method of examination was used only on the patients who were found to have "useful" or "borderline" hearing by pure tone test It is the ability to carry on conversation with others that is important to an individual, and not to hear a series of pure tones An important observation in this regard was made, in that, results of the old-fashioned testing by conversational voice with proper masking closely paralleled the findings by recorded speech, however, it was found in some cases that there was considerable discrepancy between the pure-tone threshold and the SRT

TABLE 8
DIFFERENTIAL SECTION VIIIth NERVE
HEARING

Group	Hearing Useful or Borderline (Audiogram)	SRT Discrepancy Yes	No
Group I (10 to 20 years)	1	1	0
Group II (5 to 10 years)	6	2	4
Group III (0 to 5 years)	9	5	4
Total	16	8	8

For purposes of comparison we attempted to establish a differential between these two methods of testing the retained hearing. The term "SRT Discrepancy" has been used to indicate an additional loss of greater than 10 db for recorded speech, over that found by pure tone examination. This provides the additional information that, of the 16 patients in all postoperative periods found to have "useful" or "borderline" hearing, one-half showed a discrepancy when tested with recorded speech. This discrepancy agreed with the results of testing by ordinary conversational voice, as noted above. This did not necessarily mean that these eight patients should be relegated to the "useless" hearing group but only that there was a discrepancy between the two methods of testing (that is, pure tone and recorded speech). In fact six of those showing a raised threshold for recorded speech still retained a conversational level, with proper masking, varying from three to six feet. These patients were not tested by the "free field" method.

3. *The Subjective Hearing Findings*

A common statement given on re-examination was "my hearing was the same immediately following the operation and lasted for a number of years but has gradually slipped away since then." These patients were asked to estimate the period of useful hearing they retained.

TABLE 9
DIFFERENTIAL SECTION VIIIth NERVE
HEARING — SUBJECTIVE FINDINGS

Group	Total No. of Patients	No. with Useful Postoperative Hearing	Average Period of Useful Hearing	Useless Preoperative or Postoperative
Group I (10 to 20 years)	16	4	7.5 years	11
Group II (5 to 10 years)	13	3	3 years	10
Group III (0 to 5 years)	9	1	1 year	8

This group (37 patients) showed "useless" hearing at examination neurosurgical service in this survey

This table indicates that there probably is an extra group who have had a period of useful hearing which did not show at the time of examination While there is no proof of this statement, it still means that eight additional patients *believed* that they continued to have useful hearing for a varying period of time

Good preoperative hearing records were available for 24 of the 37 patients examined within 10 years of operation (Groups II and III) Seven had useless hearing preoperatively, and of the remaining 17 with serviceable hearing before surgery, 11 had retained useful hearing for conversation in a normal environment at time of examination, as judged by the standards previously mentioned

To summarize the findings on hearing It is fair to state, on the basis of these figures, that hemisection of the VIIIth cranial nerve for labyrinthine hydrops offers the patient about two chances in three (11 in 17) of retaining useful hearing in the operated ear for a varying period up to 10 years This hearing will deteriorate, and is unlikely to be present after 10 years

Comparison of our findings on residual hearing with those reported for Dandy's cases is not possible, since the latter were analyzed from a different viewpoint and apparently were not tested for reception of speech

PATIENT'S SUBJECTIVE REACTION TO OPERATION.

Most of these patients were very grateful for the relief they had obtained from their dreaded attacks of dizziness Such comments as "made a new life for me," "would rather be dead than the way I was," and "haven't missed a day's work since" were frequently given Even with severe unilateral deafness and unremitting tinnitus, their enthusiasm for the operation and their surgeon persisted

SUMMARY

The clinical review of this group of patients with the typical triad of symptoms has shown briefly these findings

1 *Vertigo* Approximately the same number as quoted in Dandy's series obtained complete relief from this symptom (83 0 per cent)

2. *Tinnitus* This symptom was improved in 41 5 per cent of cases.

3 *Hearing* a. In an appreciable number of cases, useful hearing for pure tones was maintained for a limited period In only one case was this true after 10 postoperative years and this patient showed a still active caloric response

b Half of the group which showed useful levels by pure tone test were found to have a significant discrepancy in their reception of recorded speech. This proves that the final assessment of retained hearing must not be by pure tone audiometry alone.

4. *Subjective reaction.* Eighty-five per cent of the patients were enthusiastic or pleased with this operative procedure, and five patients (9 4 per cent) had failure due to development of hydrops in the unoperated side From history, the group of 15 patients operated upon from 10 to 20 years ago, stated in four instances that they had useful postoperative hearing which was retained for an average of seven and one-half years.

CONCLUSIONS

1 The postoperative results of differential section of the VIIIth nerve have been discussed

2 This operation is very satisfactory for the rehabilitation and relief of the patient suffering from the symptoms of severe vertigo in hydrops of the labyrinth

3 Improvement in the symptom of tinnitus cannot be assured

4 The advantage of preservation of useful hearing following this procedure has been established This hearing does regress but gives many patients an advantage which is denied them by destruction of the labyrinth Intracranial section of the vestibular nerve is the operation of choice for those patients with deafness in the unaffected ear and for those with good preoperative hearing in the diseased side If the preoperative hearing is below that considered useful to the patient, either operation is of equal value

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Thanks are due to Dr K G McKenzie and Dr E H Botterell for permission to include some private as well as public patients from the neurological service in this survey

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Room 82, Banting Institute, 100 College Street

AN OSLER ITEM

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My first meeting with Osler was during the First World War Before the United States became involved, a hospital unit was formed under the auspices of the Harvard Medical School It went to France under the name of "The First Harvard Unit." It enlisted under the British and wore modified English uniforms. The service was for four months, and then another unit from Harvard took over It was stationed at Dannes-Camiers, General Hospital 22, as a neighbor of the Canadian hospital already there from the start of the war On the way to France the Harvard Unit was invited to Oxford by the Oslers I then had a chance to shake hands with Osler but that was all, because Dr Osler and Mrs Osler who went as far as London with the unit and did war work there during the stay of the unit in France, soon found out that they both were interested in book collecting and promptly paired off and we saw but little of them until the party was over and it was time to thank our hosts and say "goodbye '

My second and last meeting with Osler was at a dinner given by Gen Birkett, the commanding officer of the Canadian hospital, under whose wing, so to speak, the Harvard Unit served and was coached in Army Medical Regulations I cannot recall what Dr Osler talked about but I well remember that the dinner was pleasantly wet. When it was over, and I was on my way back to my tent I tripped on the guy rope of a tent and woke next morning to find that I had a broken rib, a finding which I kept religiously to myself for the next four or five weeks When I finally did mention the incident, there was such a general raising of eyebrows that I relapsed into silence again

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Recently I began sending my medical books to the Oto-laryngological Library at the Infirmary I am realizing, as the saying goes, "that you cannot take them with you"

A few days ago I brought down to my small working library in my bedroom where I now do my writing, my copy of Osler's "Practice of Medicine," written as the title page says, "For Practitioners and Students of Medicine" It was one, if not the first, of the medical books that I owned The edition is dated 1893, which was my first year in the Harvard Medical School, now 60 years ago, lacking one year I found reading Osler at that time was like reading a story book I still remember vividly the glow I got from it No other medical book over the many years has repeated this Naturally I am tender about this volume

On the first fly leaf I found a small, hand-drawn book plate measuring an inch and one-half by two inches This pleased me because it did not have the amateurish look of many of my early attempts at art As was the fashion of the day, the book is bound in leather Both covers are yellow-brown with age, both have a shaky hold where they join the back of the book, and the edges of the covers are badly frayed For many years now, medical books have been bound in cloth, and soon will probably be bound in plastic Books so bound have neither the appealing color of calf skin nor its intriguing softness to the touch Only a woman's skin can equal it I just said that I was tender about this first medical book of mine, and it is obvious that I am also sentimental about it

This slight article is the first thoroughly reminiscent one of the many and almost yearly medical articles I have written I hold that everyone has a constitutional right, although this is not specifically so stated in The Bill of Rights, to write one nostalgic article, and this I am now doing

With Osler's book, where I now can easily reach it, I glanced through it a little in order to see my present reaction Only a faint memory of the glow of the first reading came back Medicine was a new world to me then, it is an old world now

Hurriedly I looked through a few chapters at random to compare their style with that of the present day medical books which surround and almost smother me The first thing which struck me was Osler's simple, straightforward, but adequate English. Wherever I looked, kindliness seemed to flavor the book.

It happened that I opened to the chapter on diphtheria The chapter dated itself and the book by not mentioning in the treatment of diphtheria the use of antitoxin This was natural as antitoxin did not then exist Next I glanced through the chapter on appendicitis and then a short chapter on sunstroke at the end of the book In the chapter on appendicitis I was curious to see what credit was given to Fitz, who was one of my instructors and professor in the Harvard Medical School It was generally believed by us medical students that he was the discoverer of appendicitis All medical students of my time rated a discoverer in medicine as a superman, therefore, to be in a class under Dr Fitz was something like meeting a second Columbus All of us, however, dreaded to be quizzed by him His manner was icy and direct, and his questions had a dagger like thrust. Each, as his name was called, came down from the raised amphitheater seats in the Bulfinch Ether Dome, and I for one stood there trembling Dr Fitz sat in the pit of the amphitheater by the side of the patient who was to be discussed On his left and behind him, leaning against the wall, was the Egyptian mummy of pre-ether days, and directly behind him in a glass case was Morton's first ether sponge and a sparkling set of Luer's amputating knives with glorious ivory handles

The third chapter I chanced upon was a short one on sunstroke. In this I felt again, and sharply, Osler's oft recurring human touch In speaking of the treatment of sunstroke, he wrote, "In cases in which the symptoms are those of intense asphyxia and in which death may take place in a few minutes, face bleeding should be practiced, a procedure which saved Weir Mitchell when a young man" At the time this was written, Weir Mitchell was at the height of his fame and known to all of us students

Under Osler's name on the title page of his book, there i
astounding list of his professorships In the English spea
world he became an international figure He lists his n
as William Osler, like Washington having no middle nam
having dropped it I cannot imagine his ever being ca
"Bill" Neither can I picture Washington being called
thing but "George"

The official list of his professorships is as follows

Professor of Medicine...................John Hopkins Universit

Physician-in-Chief ....Johns Hopkins Hospital, Baltimo

Formerly Professor of the Institute of Medicine,
McGill University, Montrea

Professor of Clinical Medicine,
University of Pennsylvani

Professor of Medicine............Oxford University, Englan

I know of no other English physician who was ever ca
to so many universities What illuminating experiences
must have had with university faculties As far as I kn
he was too forgiving ever to write about them, and I mi
add that he could not have escaped seeing what shining
easy marks the ivory towers of the non-clinical professors
a medical faculty are I have seen this in one medical facu

When Osler was at Oxford holding his last professorsh
and I was well along in the practice of medicine, I happe
to become an alumnus of the University of Pennsylvania
receiving a degree from there This gave me a slight feeli
of comradeship with Osler It goes without saying that t
was the nearest I ever got to him medically

In looking over old medical books, I always find the adv
tisements at the end not a little fascinating In Osler's "Pr
tice of Medicine" I was stirred and warmed by the outstan
ing names of so many of the authors of the various boo
Many of these men were the medical gods of my beginni
days in medicine One could find, I am sure, in their boo

obvious hints of important medical discoveries to come I was especially struck by the title of one book which was listed as follows Tyndall (John), "Esays on the Floating Matter of the Air in Relation to Putrefaction and Infection, 12 mo Cloth $1 50" I was a bit disappointed that it was not a larger book and bound in leather like Osler's "Practice of Medicine" which inspired these nostalgic pages

Recently, speaking of teachers of medicine with a close friend, we got onto the subject of the outstanding teachers of his day and mine. He said that he wondered if as many of the present-day teachers would rank with Osler and the rest of the well known teachers of our day We rather thought they did not. Youth often makes its heroes early, and often they are still its heroes when age fondly looks back upon them, yet rainbows fade, and haloes can Today medicine is too broad and split by specialities for any man to grasp it as a whole, or to put it in simplified perspective or make it fundamentally human as it is essentially To credit Osler with the ability to do all of these things would be asking too much of any man yet born, yet, he could and did do many of them

In closing allow me to say that I am still very grateful to Osler for making my beginning days rich with the promise and glamour of medicine Some of both, when time and circumstance have been unkind, have been dimmed momentarily yet, my best wish for a medical student is that he may duplicate my happy start.

127 Front Street.

NASAL IMPLANTS *†

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Los Angeles, Calif

For use as dorsal nasal implants inert metals, moulde plastics, bone and cartilage, have for the most part displace a host of other materials, and clinical experience with eac of these four is the subject matter for this study

PLASTICS

I shall first discuss the use of plastic implants which ai premoulded to form and placed under the skin

When inserted, these premoulded prostheses can result i cosmetic improvement more striking than that accomplishe by any other technique The plastic is inert and well tolerated There is no danger of absorption or warping, and it requires no modeling skill on the part of the surgeon, or preparation at the operating table

The method, therefore, offers a most tempting fool's paradise for the unwary It was widely used immediately after the recent World War, but the disadvantages soon became apparent Tissue can never grow into the plastic insert to fi it, so that it sits as an unattached foreign body, freely movable from side to side To overcome this disadvantage holes and channels have been drilled through the plastic in the hope that fibrous strands growing through them will tend to fi the implant, but fibrous strands do not grow through them, and this technical modification, therefore, does not result in the implant's becoming satisfactorily fixed at all

The circulation of the overlying skin sometimes becomes impaired, and because of this, upon exposure to low tempera-

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†From the Department of Surgery School of Medicine University of California at Los Angeles

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tures the nose may become cold or painful Due to nature's laudable attempts to develop a collateral circulation, the skin is apt to be discolored, leaving it red or purplish with vascular injection and prominent venules, all of which are very unsightly

When the plastic prosthesis is removed, a long time elapses before the condition of the skin becomes normal if it ever does. For these reasons the use of plastic prostheses has but little place in rhinoplastic surgery, or at least not for the correction of saddle nose or to replace the bony dorsum

METALS

Metals such as Tantalum and Vitallium have been widely used in the nose in many forms, a technique for which has recently been described by Fox[1]

The septum is able to tolerate large sections of tantalum perfectly well providing it is not inserted too far anteriorly into or near the columella where movements of the nose will cause erosions of the skin with subsequent infection The mucosa, however, will not grow over sheet tantalum and therefore, a mucosal covered closure of the septal defect is not to be expected The use of tantalum in this manner is therefore, of limited value and after some experience with it one tends to be dissatisfied and to discard its use

Tantalum as a dorsal implant for the treatment of saddle nose is usable in many forms including sheet tantalum bent to contour I first used it because of the peculiar needs of a football player whose season was about to begin

This patient had a badly macerated and deviated septum completely occluding both nares adequate correction requiring a dorsal implant. Autogenous cancellous iliac bone was suggested but refused by the patient because of the incapacity that might result at the donor site during the early days of the approaching football season. It was therefore, decided to substitute for the bone graft a simple plate of heavy sheet tantalum bending it into an arch or gable simulating that of the nasal bones to serve as a temporary support

Figure I shows the A-P and lateral X-ray views of this simple tantalum arch, its edges blunted by a dental technician accustomed to working with metals This served its purpose admirably, giving a good cosmetic and functional result (see Fig II-A) The patient played the entire season of football with a Pacific Coast Conference freshman football team, and suffered no ill effects The blood supply to the skin remained good, and it suffered none of the vascular problems described under the plastic protheses Whether it might have, had the tantalum been left in longer, I do not know

After a few months as underlying scar tissue began to contract, an unsightly ridge, as demonstrated in Figure II-B, appeared across the dorsum at the level of the lower end of the implant between it and the lower lateral cartilages

It was, therefore, planned to remove the tantalum and substitute a cancellous bone graft from the iliac crest, however, after removal of the tantalum the contour of the nose on the operating table was still very good, a build-up of firm fibrous tissue under the metal arch evidently having produced a rigid supporting structure It was, therefore, decided to wait before doing the hip graft in order to observe the result without it After a few months with nothing more having been done, the unsightly ridge disappeared, the cosmetic result was still adequate and no further scar tissue contraction, to affect contour adversely, had taken place (see Fig III-A) The hip graft after two years has not been considered necessary The temporary use of the tantalum arch, therefore eliminated the need for an implant, the growth of fibrous tissue under it having sufficed (see Fig III-B)

The excellent manner in which sheet tantalum was tolerated under these unusual conditions of trauma stimulated our further interest in the use of this metal, and I can report upon a more or less extensive experience with it in various forms over a three year period Tantalum mesh has emerged as the material of choice and when folded over and over gives a most satisfactory implant which can be cut to shape and bent to contour (see Fig IV)

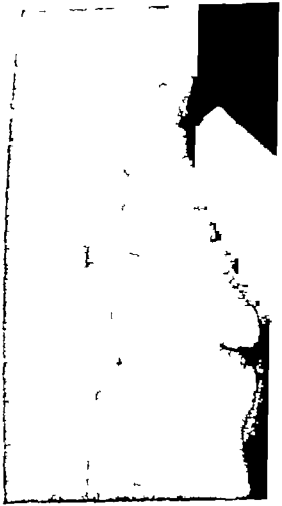

Fig I Right side

Fig I Left side

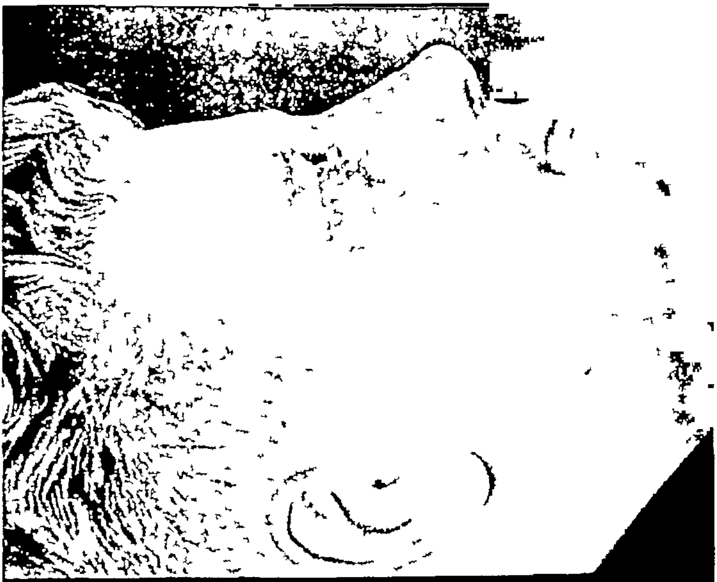

Fig II-A

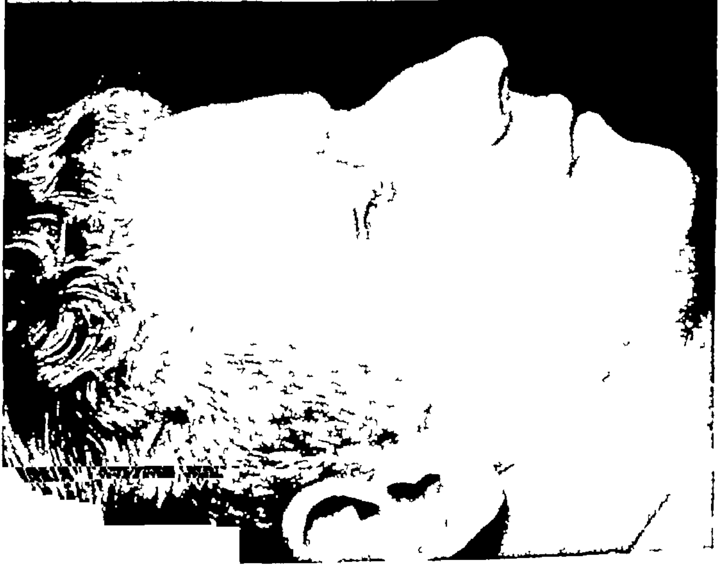

Fig II-B

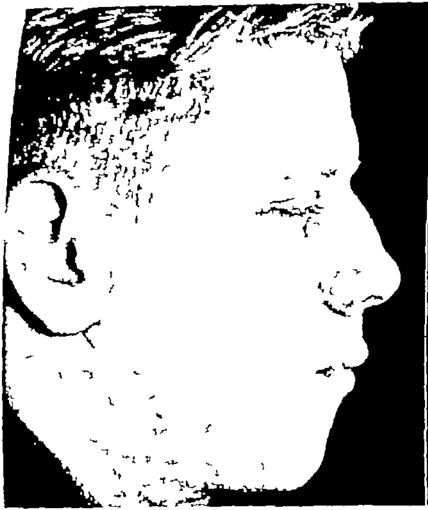

Fig III B.

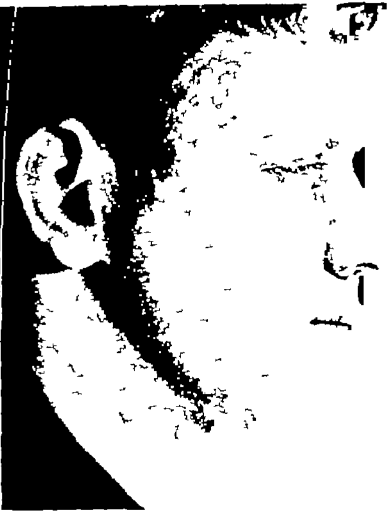

Fig III A.

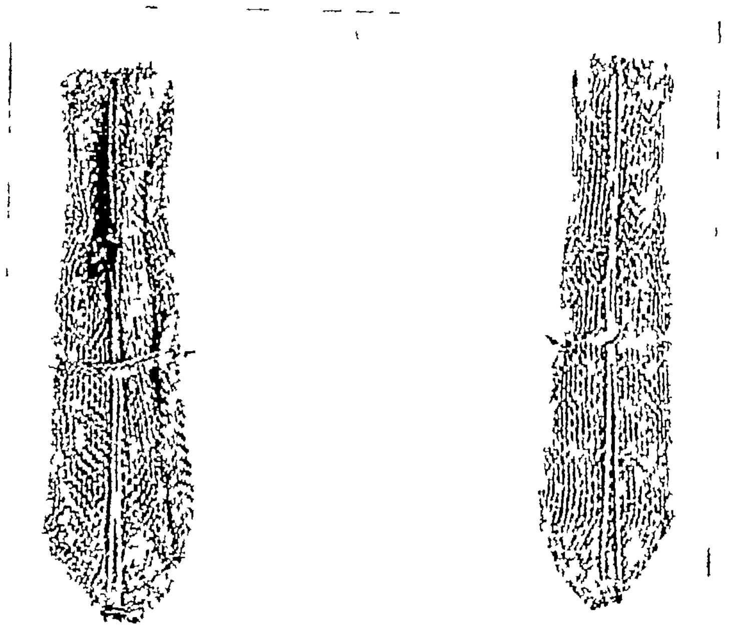

Fig IV

Figure V demonstrates such a prothesis *in situ* Note that in addition to the dorsal implant there are two mesh rolls, one used as a columellar strut and the other as a tip strut The cosmetic result can be very good as Figure VI and Figure VII show

The implant was well tolerated, and I quote the follow-up note on this patient's chart approximately a year after the operation, since it summarizes several points of importance The note is as follows

> "The plastic effect is pleasing There is no evidence of any complication pertaining to either the dorsal or columellar implants The interior of the nose is completely healed The dorsal graft is well fixed *in situ* without unusual mobility and certainly not more than one would expect from a bone graft The patient's skin is in excellent condition He has been constantly exposed to the sun

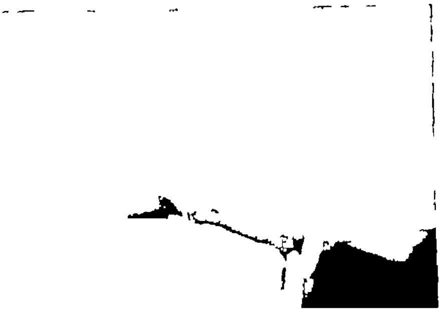

Fig V A.

Fig V B.

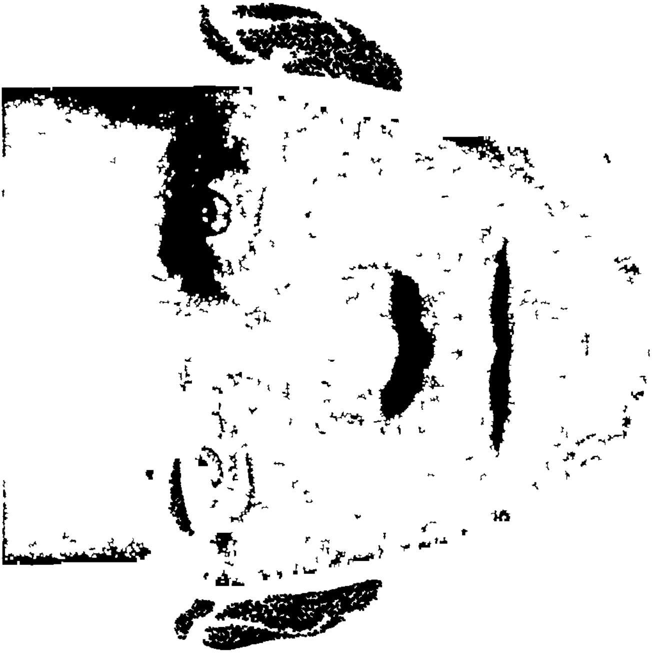

Fig VI-A.

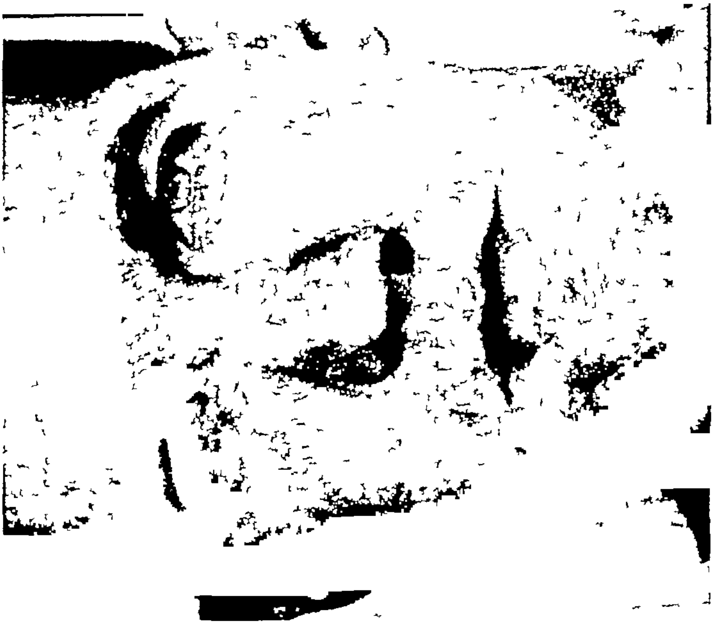

Fig VI-B

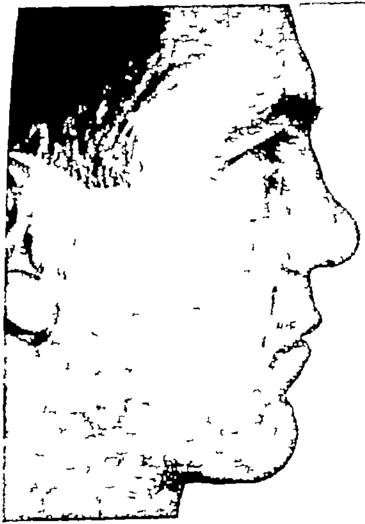

Fig VII B.

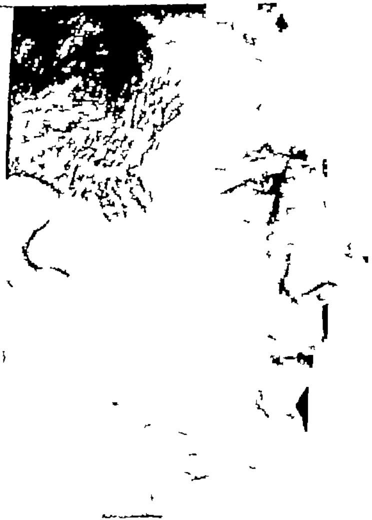

Fig VII A

as a parking lot attendant which exposure is well tolerated There are no untoward effects from exposure to cold The nasal tip is mobile and soft"

A month or two after this note was written and without forewarning, almost 14 months postoperatively, the small columellar strut sloughed out while the patient was away from home, but no appreciable change in contour resulted Two years postoperatively a small granuloma developed at the junction of the lower and upper lateral cartilages on the left side with some drainage The complication was considered to be due not to the nature of the implant but to its length which was greater than it should have been, resulting in a small point of erosion at the junction of the upper and lower lateral cartilages on the left side An incision was made between the upper and lower lateral cartilages, carried across the midline, and the skin elevated off the implant for a short distance The tip of the insert was found to be lying in the granulations, having eroded through at this point Approximately a centimeter of the lower end of the tantalum was removed Complete healing took place and if anything the cosmetic result was improved

It should be interpolated at this point that while metallic dorsal implants have in most cases been well tolerated, this is not true of struts placed in the columella as battens for stiffening Apparently due to the constant movement of the columella eventual erosion takes place with loss of the metallic strut, however, if this has been delayed for a sufficiently long period of time dense fibrous tissue will have been laid down which in itself acts as a satisfactory stiffener, so that the loss of the implant is of no consequence

As far as the large dorsal implant itself is concerned, fibrous tissue rapidly grows into the meshes firmly fixing the graft, which blends into the structure of the nose almost as if it had been intended by nature to grow there The surface soon becomes covered with a layer of fibroblastic tissue which grows deeply into the substances of the mesh Such inserts become more intimately blended with the surrounding tissue, and more firmly fixed than any other substance not excluding cancellous bone and can be removed only by sharp dissection and then with difficulty

Early in the course of our experience with metals, and based upon theoretical grounds rather than actual experience, it seemed as though the use of a mesh might result in undesirable fixation of the skin to the underlying graft, so that a section of very thin curved tantalum sheet metal or foil was wrapped over the top surface of the mesh separating it from the skin This was intended to permit the skin to slide more freely over the graft as it normally does over the smooth nasal bones, and this proved to be the case, however, when it was not used experience proved there is no interference with the mobility of the skin over the mesh itself so that the use of this sheet of foil over the mesh roll was discarded, and I mention it only for the sake of completing the details

Tantalum mesh, therefore, rolled, moulded, and cut to contour is a most satisfactory implant and deserves further investigation I have had a few unsatisfactory results almost invariably consisting of erosion of the nasal lining at the junction of the lower and upper lateral cartilages with subsequent local secondary infection which is characterized by a slight foul discharge and the formation of a slight amount of granulation tissue but there are usually no other signs or symptoms On one or two occasions, a few weeks after surgery, there had been some low grade infection with local redness and edema, which was allowed to subside under treatment by antibiotics and hot packs The implant was then removed after which complete healing always took place A period of time was then allowed to elapse, and the incident was not considered a contraindication to the placing of another implant.

The cause of such unsatisfactory results was in each case carefully studied and evaluated with invariably the same findings which I have previously mentioned and now repeat for the sake of emphasis Failure invariably results when the implant is too long This produces erosion of the mucocutaneous lining, most often at the junction of the lower and upper lateral cartilages with subsequent infection

The criterion for proper length is that there shall be no interference with free movement of the entire tip of the nose A too long graft tends to fix the tip whereas one of proper length allows it to be moved freely in all directions

The temptation to use an unduly long graft, however, is very great, since on the operating table immediate cosmetic effects resulting from the use of long grafts which support the tip as well as the dorsum can be very pleasing This temptation, however, must be avoided at all costs since failure to avoid it will result in loss of the graft

If, after apparent healing, erosion of the lining mucosa occurs and secondary infection, no matter how low grade supervenes, there is no point in attempting to save the graft, for even if by energetic therapeutic measures the infection is overcome, this will be only a temporary respite and should be used as an opportunity to remove the graft Permanent cure of the secondary infection, no matter how mild, results only from removal of the cause which is the implant itself It can at a later date, and as a subsequent procedure, be replaced There is one exception, if the implant is too long, and the infection not acute, an attempt may be made to shorten the implant without removing it

One very recent case, hospitalized within the last day or two, has suffered a severe local and systemic infection following the insertion of a tantalum mesh graft Redness, swelling, localized sloughing of a portion of the skin of the lateral aspect of the dorsum occurred It is too early to surmise the final result It is of some importance that one year previously this same patient suffered a similar but less violent local infection following the introduction of a boiled cartilage graft which subsequently was completely absorbed

BONE

In 1945 Samuel Foman, Romeo Luongo, Alfred Schattner and Frank Turchik' concluded that insofar as transplants for the correction of saddle nose are concerned, "cancellous bone obtained from ilium is the material of choice,' by virtue of the fact that it most nearly fulfills the requirements they laid down for an ideal nasal transplant These requirements are essentially as follows

1 The material must be readily available in sufficient quantity

2 Permit of easy modeling

3 Be well tolerated by the tissues and resist infection and absorption

4 Be not subject to change in shape after implantation

These criteria leave little to be desired, but it is difficult to entirely agree that cancellous bone from the ilium actually satisfies them For instance, whether the removal of cancellous bone from the depths of the ala of the ilium constitutes ready availability' is open to argument, and the criterion of "sufficient quantity" would surely be more adequately fulfilled if something were left in case of spoilage of the graft, or a greater excess of bone were present for purposes of modeling In some instances the amount of cancellous bone available from between cortical layers is barely enough

Concerning the third criterion of those enumerated there can be no doubt that cancellous bone is well tolerated by the tissues and resists infection but it is not by any means resistant to absorption

Clinically in almost all cases some absorption of the bone implant takes place, and in an appreciable number of instances the degree of absorption is sufficient to spoil the clinical result. In one such case a year after the graft was inserted the pleasant cosmetic effect originally achieved, as shown in Figure VIII-B was entirely ruined by the absorption of the cancellous bone graft Figure VIII C shows the deterioration in appearance as a result of absorption of bone

This is probably an extreme case but shrinkage to some degree occurs in almost all cancellous bone grafts In most

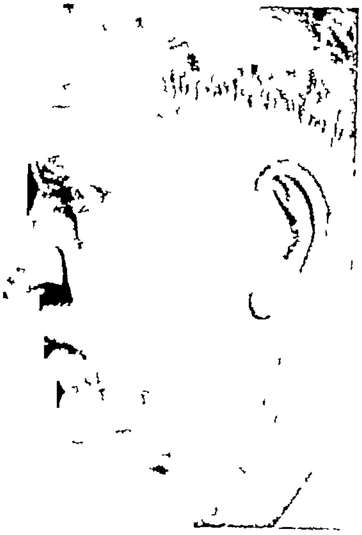

Fig VIII-C

Fig VIII-B

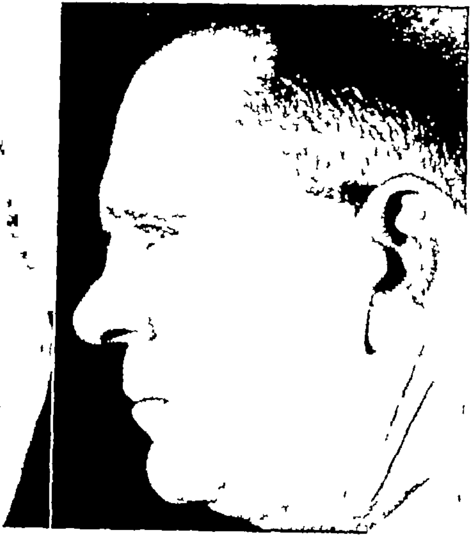

Fig VIII-A

of them, however, the amount of absorption is what might be called 'subclinical" not affecting the result to the point of its becoming cosmetically unacceptable.

The fourth criterion (that the graft be not subject to change in shape after implantation) cannot, of course, be fulfilled by those cancellous bone grafts which have undergone marked absorption In these latter instances a decided change in shape, as I have pointed out, obviously occurs, but otherwise the cancellous bone graft fulfills this requirement very nicely It ordinarily becomes firmly adherent to the surrounding tissue and does not warp or become distorted in shape in any way

Since this presentation is intended to be entirely clinical, I am purposely avoiding reference to the histological changes taking place in the bone grafts and do not want to enter into a discussion of the fate of the living cancellous bone cells or their survival or replacement by other cells, but, in general, the fate of any autogenous bone graft and the ultimate histological structure it assumes varies, for one thing, with the type of tissue with which the graft is placed in contact. Thus an autogenous living bone graft from the femur placed in contact with femur will remain as bone because of the osteoblastic activity of the osteoblastic host site, and the latter's ability to regenerate bone, but this is not true of bone placed in contact with nasal bones The nasal bones[3] in common with the bony structures of the nasal septum do not have the power of bone regeneration, therefore, a bone graft placed in contact with them, as is the case in the problem I am discussing, does not have the advantage of osteoblastic activity from the host site. This very appreciably lessens the chance of survival of a bone graft transplanted into the nose and its disintegration, and replacement by fibrous tissue is, therefore, almost inevitable. Peer and Walker[4] found that all such grafts were replaced by fibrous tissue in eight months. Sometimes, however the fibrous tissue which replaces the graft is adequate to maintain a satisfactory cosmetic and functional contour, but this is largely a matter of chance From observations on bone grafts it is necessary to conclude that while often cosmetically effective, they are not by any means foolproof and contrary to the current opinion of many authorities, my own personal experience indicates that the use of cancellous bone is not the method of choice

CARTILAGE

An adequate discussion of the use of cartilage requires that three classifications be considered

The first of these is the transplantation of living cartilage in the form of an autogenous graft such as a segment of rib Cartilage, if its cells are alive when transplanted, survives as living cartilage regardless of whether it is transplanted into a bed of like or unlike tissue If cartilage is not alive when transplanted it nevertheless persists for many years in its transplanted form, but without living cells Peer and Walker point out its gelatinous matrix is the most durable of all intercellular substances

Autogenous living cartilage, therefore, because it is readily sculptored to contour [illegible] available, easily removed from the host area, present in abundant quantities and able to survive as living cartilage regardless of whether it is placed in contact with like or unlike tissue, would seem at first glance to provide an entirely suitable substance for dorsal grafts, but living cartilage when transplanted presents a most serious disadvantage with which I am sure you are all familiar It curves upon itself or as we say, "It curls"

The tendency to curve or curl after implantation is true not only of live cartilage but also of preserved cartilage Why this curling occurs after implantation and not before is beyond my understanding but such is the case Cartilage would be almost ideal if the curling could be made to take place prior to its use, which statement brings me to the crux of the whole case for the use of cartilage New and Erich for a long time have advocated the use of cartilaginous grafts boiled prior to implantation The boiling curls the cartilage as much as it can or will curl, and if a large enough piece of cartilage is used, then from the curled specimen a graft can be sculptured which is practically immune to further curling The cartilaginous cells, of course, will be dead and the graft ultimately, by an extremely slow process, will be replaced by fibrous tissue which strangely enough has a peculiar tendency to calcify Fibrous tissue over a perod of years replaces the cartilage very gradually, without appreciable or significant loss of contour The graft soon becomes firmly fixed *in situ*, the skin moves freely over the surface, and all in all in the vast majority of cases an entirely suitable graft results

Boiled cartilage, therefore, more closely than cancellous bone would seem to fulfill Fomon's requirements for a satisfactory dorsal graft or implant. After four years of observation covering perhaps 100 grafts which although not an extensive experience, nevertheless qualifies one to have a definite opinion, I have a preference for the use of boiled homogenous cartilage over the use of living autogenous cancellous iliac bone.

The question arises as to whether or not, like bone, absorption of these cartilaginous grafts may take place to a sufficient extent to spoil the plastic result. In some cases it most certainly does, and the cartilaginous graft may be completely absorbed, but this does not happen very often, and in my experience, considerably less frequently than in the instance of cancellous bone grafts from the hip

Since compromise and risk of some sort is inevitable in such cases as these, there being no entirely satisfactory material available, a reasonable percentage of losses of cartilaginous implants by absorption is not to be considered an unduly serious disadvantage particularly since a new graft can be inserted without too great a sacrifice on the patient's part This is not true of cancellous bone

As experience with tantalum mesh cut to proper length grows more extensive my enthusiasm for its use constantly increases despite the fact that it constitutes the introduction of a foreign body but it must be tapered at the tip so as not to impinge upon the junction of the upper and lower lateral cartilages, and it must be short enough to permit full mobility *of the tip of the nose* It has *one important* additional advantage in that the tantalum mesh can be folded in such a manner that the proximal end of the prosthesis is thin, thus adapting itself perfectly to the contour of the root of the nose without unsightly bulging or undue prominence

It is not possible to omit mention of the use of polyethylene sheeting cut to contour for use as either columellar battens or for dorsal tip struts or battens This now, in all my cases, replaces septal cartilage or rib cartilage which in small thin segments is technically difficult to use without breaking I have no statistics on the actual number of extrusions of this material as compared to cartilage, but it is certainly not greater In 50 or 60 cases only three have been lost The plastic is inert and causes no untoward local reaction, has a desirable degree of elasticity that cartilage lacks and is very easy to use with proper guide sutures I find it superior to cartilage in every way

This material, with puncture holes, also serves admirably to replace the nasal septum which is a subject to be covered in a subsequent communication

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CAUSES AND MECHANISMS IN RHINITIS *†

STEWART G WOLF JR., M D (by invitation),
Oklahoma City, Okla

As mere internists, my colleagues and I would never have had the temerity to investigate the nose and rhinitis without the help and advice from those in your midst, chiefly Dr Gervais W McAuliffe, at Cornell, and Dr Edmund P Fowler, Jr at Columbia We became interested in nasal membranes because for several years we had been looking at the stomach of an individual with a large gastric fistula In this stomach there occurred very marked changes in turgidity and color of the gastric mucous membrane which came and went with changes in the individual's day to day situation in reaction to a great many stimuli

During the past few years there has been a rapidly growing concept in medicine that pathophysiologic processes and what we customarily classify as syndromes or diseases are not necessarily attributable to one etiologic agent It is becoming increasingly clear that the same biologic pattern may be called forth in response to a variety of noxious experiences Recently there has been evidence that even symbolic noxae, that is, words or events which threaten the security of the individual by reason of earlier conditioning experiences, may initiate pathophysiologic reactions and lead to structural organic disease

Our study involved the direct examination of the noses of a large number of people under a wide variety of circumstances Examinations were carried out under standard conditions of lighting A warmed nasal speculum was used for

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Read at the meeting of the Eastern Section American Laryngological Rhinological and Otological Society Inc., New York, N Y., Jan 11 1952

†Based on experimental studies done in collaboration with T H Holmes, H. Goodell and H. G. Wolff and adapted from the book, "The Nose" Chas. Thomas New York.

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inspection of the structures but no further instrumentation The range of nasal functions, including degree of redness of the membranes, swelling, secretion, and obstruction, were roughly quantitated

It was found that individuals vary greatly in their nasal reactivity Some displayed wide variations from time to time in color, swelling, and secretion, while others varied but little

The experimental subjects were exposed to a series of environmental threats The first of these consisted of noxious stimulation of the nose with fumes of ammonium carbonate We observed the reaction which you might expect, namely, after inhalation a sudden hyperemia, swelling of the nasal structures with hypersecretion, and obstruction Associated with these nasal changes there occurred weeping, tearing, and spasm of the eyelids as well as strenuous coughing

In Fig 1 is observed the reaction time in minutes on the abscissa and quantity of secretion, color, swelling, and obstruction on the ordinate After inhalation of ammonia, there occurred a sudden acceleration of all functions This

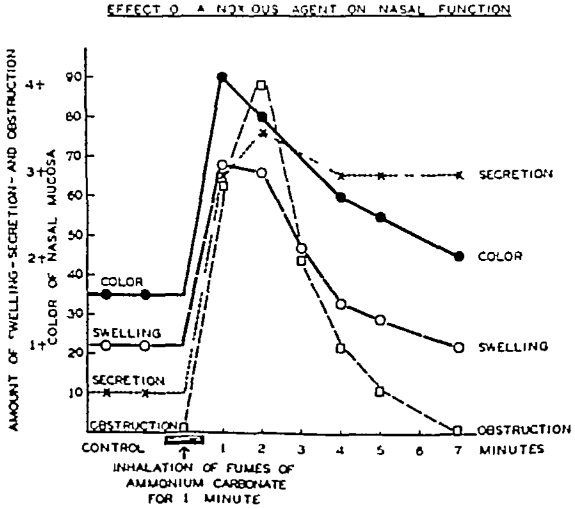

Fig 1 Hyperemia with swelling hypersecretion and obstruction of the nose following inhalation of noxious chemical agent—ammonium carbonate

was obviously a reaction of defense on the part of the organism, an effort at shutting out and washing-away and ejection of the offending substance

Another type of assault against the person comes from the inhalation of pollens to which he may be sensitive Accordingly, we studied a subject in an attack of hay fever from its very inception. Prior to the attack the septum and turbinates were of normal appearance Immediately upon beginning to cut flowers in his garden, however, the subject began to cry and sneeze. The changes observed in his nasal membranes were precisely those described following the inhalation of irritating ammonia fumes. Immediately upon inhaling the offending pollens, there occurred an extreme hyperemia with hypersecretion, swelling, and obstruction in the nose. This particular attack was an abortive one, but frequently, when the swelling of the membranes was sustained, the hyperemia subsided, leaving the membranes pale but still swollen wet, and edematous looking This pale, swollen state is the usual appearance of the nose of the hay fever sufferer when he comes to the doctor's office for treatment It is clear, however that, as in the case of inhalation of irritating fumes, the hyperemia comes first. This is another instance of the bodily reaction of shutting-out and washing-away

Our next step was to inflict upon the experimental subject a nonspecific threat, not directed at his respiratory passages Accordingly an intense headache was induced by constricting the head in a tight fitting steel crown. This was a highly unpleasant experience associated with feelings of apprehension on the part of the victim, and it provoked the same reaction of defense as that described already for more specific threats, namely, hyperemia, engorgement, hypersecretion and obstruction in the nose

The next step was to learn whether or not situational threats which did not involve the application of physical trauma would induce such a pattern of defense with nasal changes A threat was utilized, therefore, which depended for its force upon the communication and understanding of symbols which, because of past conditioning experience, had acquired a special meaning for the individual

A 40 year old itinerant salesman had noted recurrent nasal obstruction and rhinorrhea since his marriage 14 years ago Both his parents were Russian Jewish immigrants His father was a humorless, domineering baker who made liberal use of corporal punishment His mother was a tearful unhappy individual who from the date of her marriage, was almost continuously pregnant until she had 11 children The patient was the oldest. He quit school in the seventh grade at the age of 14 and began working as a traveling salesman in defiance of his father's orders to continue his education He left home and saw little of his family thereafter Two of his younger brothers later became lawyers The patient was always concerned only with his own pleasures and gratifications and never developed warm emotional ties to others

Shortly after his marriage in 1932, he opened a small retail store In the setting of failure of this enterprise he began to note persistent nasal obstruction and discharge He blamed the failure on his wife since she declined to work with him in the store The nasal symptoms partly subsided after a few months and flared up again two years later when his wife insisted on buying furniture with $800 which he had saved to start another store Again the following year symptoms recurred when she underwent a costly pelvic operation which rendered her sterile Her failure to become pregnant had been a source of great disappointment to the patient. Once in 1935 he left her for a few weeks but returned because I missed the comforts of home We never got along, but she was a good cook and a good housekeeper ' From that time on his nasal complaints became chronic never severe but moderately troublesome most of the time with frequent nose blowing and intermittent partial obstruction

While this subject s nasal structures were under observation he was disturbed by a discussion of his conflicts Prior to the interview the membranes were of normal appearance During the discussion which concerned his wife who had been asked to accompany him on the visit to the hospital so that she too might be questioned he became tense tremulous and was on the verge of tears Abruptly there was noted reddening of the nasal mucous membranes with engorgement hypersecretion and obstruction as shown in Fig 2 After the discussion was ended the subject was reassured and diverted and after another hour the nasal functions had returned toward normal.

The changes in nasal function which occur under stress and which were observed in this patient after initiation of the unsympathetic interview are in themselves often sufficient to produce both obstruction and pain Added to these however may be the complicating factor of infection from the ever present bacterial and virus organisms on the mucous membrane Given an edematous mucosa with improper drainage a pyogenic reaction may easily be set up and once established the infective process might perpetuate itself

We then examined and inquired into the life stories of several patients who came to our hospital with nasal complaints, including frequent colds and sinusitis

In a high percentage of these individuals, as reported elsewhere, it was possible to correlate the onset and recurrence of nasal troubles with episodes of situational stress and conflict, furthermore, a fairly clear-cut pattern of attitude and behavior was recognized among these subjects Their actions in meeting threats were predominantly defensive The shutting-out pattern in their noses reflected a general reaction of nonparticipation, rather than aggression in dealing with problems

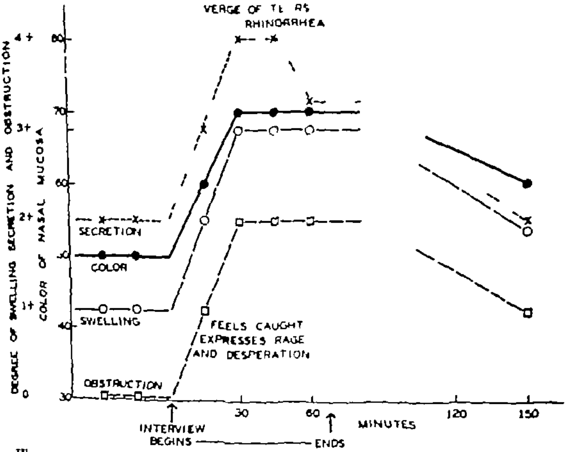

Fig –. Experimentally induced hyperemia, swelling hypersecretion and obstruction in the nose during an interview in which the subject experienced anger and resentment.

While our temporal correlations of nasal disease with adverse life situations are interesting the most convincing evidence of the relation of life situation to nasal disorders lies in the fact that it was possible with certain subjects to manipulate the situation during an interview under experimental conditions with the nasal structures in view

Another such case (see Fig. 3) was that of a 36-year-old orthodox Jewess, whose nasal obstruction and discharge had begun four years before when she found herself caught in a serious dilemma having to do with her failure to have vindicated her position when she broke away from her family tradition to marry a Roman Catholic She had given up hope of her husband s measuring up and had placed all her hopes and ambitions on her children Her nasal symptoms began when her older child was discovered to have diabetes and two years later, when her younger child became ill she developed asthma

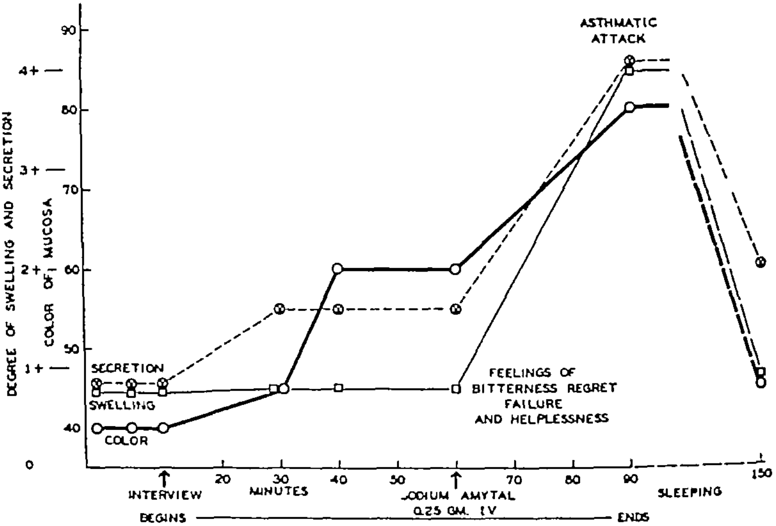

Fig 3 Experimentally induced hyperemia, swelling hypersecretion and obstruction in the nose associated with narrowing of the bronchial tubes during a discussion of topics provocative of feelings of remorse guilt and resentment.

In this woman, in three interviews under sodium amytal it was possible to turn on and off at will her nasal symptoms and asthma. During relaxation and diversion she was free of symptoms but when sensitive topics were discussed unsympathetically her nasal membranes began to swell and secrete creating partial obstruction in the nose Even her deeper respiratory structures constricted resulting in a typical attack of asthma It is clear that in response to situational threats the same changes may occur in nasal function as in response to locally applied noxious stimuli

STRUCTURAL TISSUE CHANGES AND CELLULAR REACTIONS

Biopsy of Turbinates

In an attempt to explore the characteristics of the tissue change and its mechanisms, a biopsy was made from the inferior turbinate of a sufferer from chronic rhinitis, first on one side during a control period of rest and relaxation, when the membranes were in an average state of activity, and again, from the opposite turbinate, at the height of a frustrating interview when the patient was on the verge of tears Both biopsies were made with the same technique and the same topical cocaine anesthesia The first section showed an essentially normal mucosal structure with moderate round cell infil-

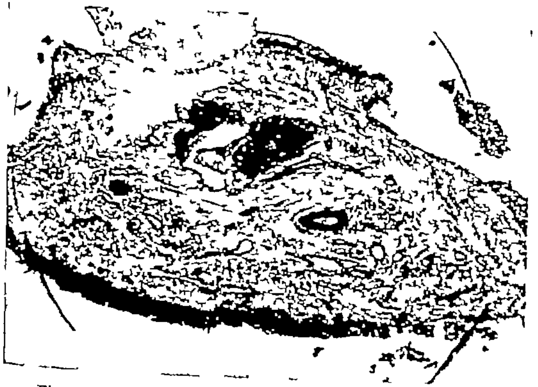

Fig 4A. Biopsy of nasal mucosa during control period.

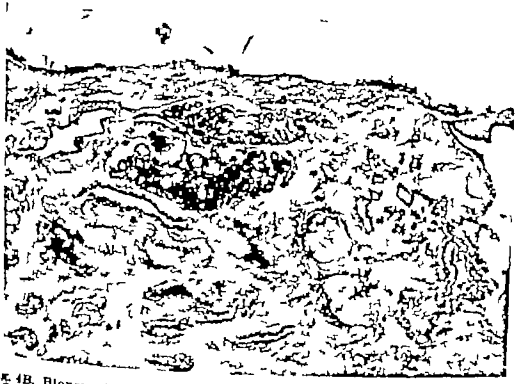

Fig. 4B. Biopsy of nasal mucosa during interview at height of nasal hyperfunction associated with emotional stress. Note engorgement of glandular structures and edema of the stroma.

tration The second revealed the mucous glands to be filled with secretion and the vascular and lymphatic channels to be prominent and dilated The lighter stroma was indicative of edema (see Fig 4)

Cell Counts of the Nasal Secretions

Nasal secretions of the subjects were collected and stained by an appropriately standardized technique before, during, and after the discussion of significant conflicts At the same time white blood cell counts were made on the peripheral blood It was found that nasal hyperfunction in association with stress was accompanied by a marked eosinophilia locally and in the peripheral blood as well The reaction is illustrated in Fig 5 In this subject, as well as others, not only was an eosinophilic reaction observed in company with stress but also a purulent response with the outpouring by the nasal membranes of polymorphonuclear leucocytes

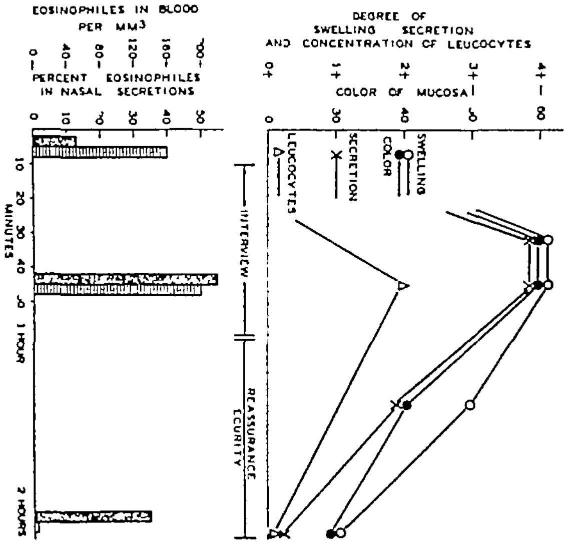

Fig 5 Cellular reaction locally and in peripheral blood nasal hyperfunction during anger and humiliation

Tissue Fragility and Pain Threshold

Other evidences of "organic" tissue changes in response to symbolic threats to the integrity or welfare of the organism were found to be increased fragility of the membrane and lowered pain threshold accompanying sustained nasal hyperfunction. Ordinarily, when the membranes were in their average state, minor traumata with the nasal speculum were neither significantly painful nor productive of bleeding Under circumstances of sustained hyperemia, however the merest contact of speculum with turbinate was intensely painful and usually resulted in erosion and bleeding

THE RELATIVE IMPORTANCE OF POLLEN AND LIFE SITUATION IN INDUCING NASAL HYPERFUNCTION AND EOSINOPHILIA

Since perhaps the most pathognomonic change attributed to allergy, eosinophilia, was observed in these patients, it became especially interesting to compare adverse life situations with pollens as to their effects upon the eosinophilic reaction Accordingly several groups of subjects, including those with strictly seasonal ragweed hay fever, those with nonseasonal vasomotor rhinitis but without ragweed skin sensitivity, and normal subjects without rhinitis and without skin sensitivity were selected and studied by the above methods In addition, they were exposed to between 100 and 300 gr of mixed ragweed pollen circulating in the air of a special pollen room without their being aware of it These experiments were carried out both in and out of ragweed hay fever season

Fig 6 illustrates an experiment on a 21-year old girl who had had strictly seasonal ragweed hay fever She was given an induced headache with the steel headband an experience to which she submitted but vigorously resented She couldn t have been allergically sensitized to this experience since she had never had it before, but, nevertheless eosinophiles appeared in her nasal secretions in significant numbers.

As already noted (see Fig 5) the same type of reaction occurred in a discussion of significant personal conflicts during ragweed season but at a time when her nasal membranes were fairly normal and eosinophiles both in the nose and blood were at a low level

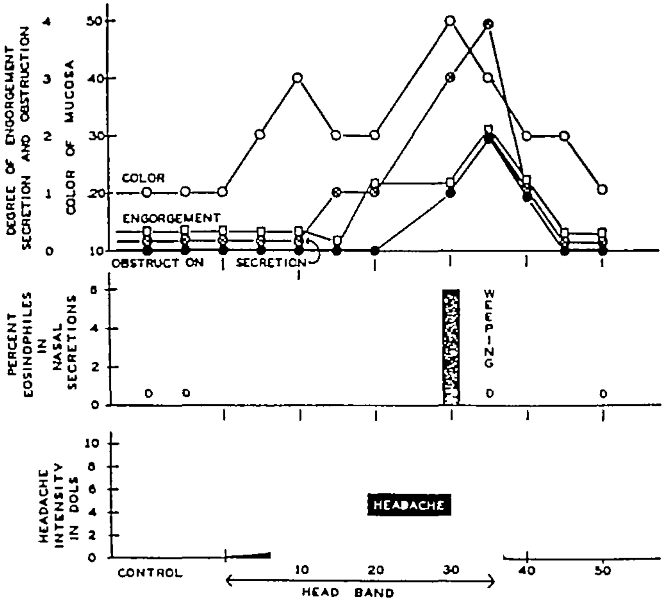

Fig 6 Production of eosinophilia in the nasal secretions with associated nasal hyperfunction by noxious stimulation of the head

Comment Generally speaking, when nasal function was average, neither "sensitive" nor "normal" subjects reacted to mixed ragweed pollen with sufficient evidence of nasal hyperfunction to produce symptoms, however, when there was pre-existing nasal hyperfunction from whatever cause, both groups reacted to the pollen with marked hyperfunction, weeping, and sneezing Thus, during difficult life situations productive of conflict, typical hay fever attacks followed pollen inhalation Conversely, it was possible during pollen inhalation in the absence of frank hay fever to induce an attack by a discussion of significant personal problems and to induce subsidence of the attack by reassurance while the pollen was still being inhaled

Fig 7 illustrates an experiment on a 57-year-old Negro woman who also had ragweed sensitivity according to skin test, but suffered from vasomotor rhinitis both in and out of season. She was interviewed in the pollen room It will be noted that nasal hyperfunction was induced upon entering the pollen room. It was apparently enhanced during the interview but finally subsided completely after successful reassurance and relaxation, although she remained in the room with the same quantity of pollen circulating

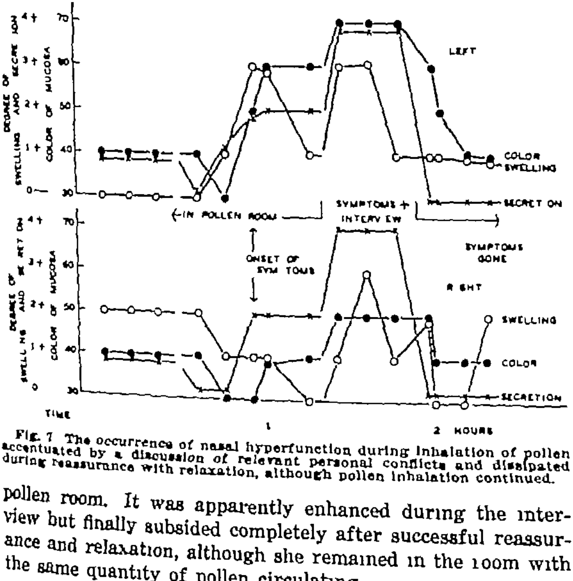

Fig. 7 The occurrence of nasal hyperfunction during inhalation of pollen accentuated by a discussion of relevant personal conflicts and dissipated during reassurance with relaxation, although pollen inhalation continued.

The next subject, shown in Fig 8 had no ragweed sensitivity and never had symptoms of rhinitis except for occasional head colds At such times, however it was possible by adding further insult, either locally to her membranes or generally to her pride to induce eosinophilia

Comment From these data it would appear that the various factors provocative of nasal hyperfunction with symptoms of hay fever thus exert an additive effect.

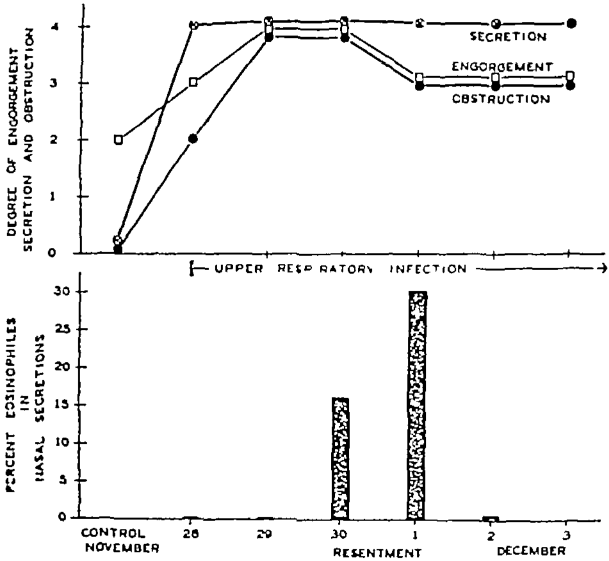

Fig 8 The additive effect of an upper respiratory infection and emotional stress in inducing eosinophilia in the nasal secretions

NEURAL MECHANISMS INVOLVED

In an attempt to clarify the mechanism of these changes we subjected several individuals to unilateral novocaine block of the stellate ganglion This maneuver eliminates the sympathetic impulses affecting the nasal membranes and allows the cholinergic fibres of the greater superficial petrosal nerve to act uninhibited

It was found that when the sympathetic supply of the nose was thus interrupted by procaine injection of the stellate ganglion, the unopposed parasympathetic supply induced a state of moderate nasal hyperfunction Such a partially denervated membrane was found to be even more reactive to noxious stimuli than usual (see Fig 9)

DISCUSSION

I would call attention to the fact that the bronchial tube is lined by the same type of mucous membrane as that which covers the nasal structures The pathology of asthma is similar to that of rhinitis — membrane engorgement with edema,

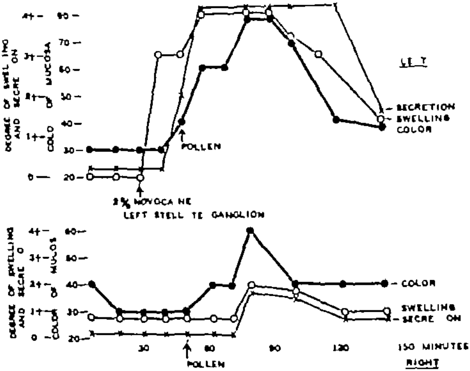

FIG. 9 Nasal hyperfunction following procaine injection of the left stellate ganglion accentuated by the inhalation of pollen with the production of symptoms of rhinitis.

hypersecretion of mucus and obstruction The membranes of the nose and bronchi are continuous Many of the patients had both diseases. In those with asthma it was equally possible to "turn on" and 'turn off" attitudes by manipulating the interview situation Detailed reports of such experiments are published elsewhere.

The pattern of reaction involving the upper respiratory tree is in essence, a defensive one of shutting out and washing away at the head end of the organism It is appropriate and effective in dealing with an atmosphere of dust, smoke, or fumes but less so with an atmosphere of hostility from human beings, and yet, however inappropriate it is quite obvious that it is invoked to deal with such threats and hazards. In fact, the various factors seem to work in concert and may set up a vicious cycle

It seems likely that transitory nasal hyperfunction from whatever cause can be well tolerated by the organism, but sustained engorgement of tissues with obstruction not only led to pain and discomfort but also may have predisposed to the development of polypi and the establishment of infection locally in the nose and in the paranasal sinuses and bronchi

It is not implied from these observations that all nasal disease stems directly from situations involving difficulties in interpersonal and social adjustments There are certainly other major factors which set in motion the chain of events described, however, situational threats involving interpersonal and social adjustments occupy a position of importance and may modify the course of the morbid process regardless of the precipitating incident

SUMMARY

1 Life situations productive of conflict with anxiety, hostility, guilt and feelings of frustration and resentment were commonly accompanied by nasal hyperfunction with hyperemia, swelling of the nasal mucosa, hypersecretion and obstruction to breathing in the nose

2 There was also observed an associated pyogenic-like reaction with an increase in the neutrophile and eosinophile content of nasal secretions

3 Biopsy obtained under these circumstances revealed edema of the stroma, dilated vascular and lymphatic channels and hypersecretion of the mucous glands

4 Cholinergic impulses to the nasal mucous membranes, probably transmitted by the greater superficial petrosal nerve, are responsible for the production of the nasal hyperfunction

5 The pattern appears to represent an attempt on the part of the organism to protect itself by shutting out, neutralizing and washing away an environment that is literally or symbolically noxious

6 Pain commonly accompanied the nasal hyperfunction It radiated from under the bridge of the nose over the zygoma, in and above the eye, in the temple, upper teeth and ear Infection of the nasal or paranasal spaces was not a necessary prerequisite for pain

7 When such a pattern is unduly sustained, pathological changes occur which give rise to or prolong troublesome symptoms and, especially when coupled with other noxious threats and assaults, become important to the pathogenesis of chronic nasal disease

TRAUMATIC RUPTURE OF THE TYMPANIC MEMBRANE *†

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Mechanical perforation of the tympanic membrane is seen by the otolaryngologist occasionally in civilian practice but probably more frequently in military patients In civil life the injury is usually caused by blows upon the ear forcible impact of water as in diving, and actual perforation by mechanical objects In warfare the most common cause is the explosion of high powered missiles Except for actual mechanical perforation, the mechanism is the powerful impact of air or water upon the eardrum

The most common symptoms are deafness, tinnitus, and sometimes a sensation of fullness in the head Occasionally a small amount of bleeding will be present If there is a secondary otitis media, there will be a purulent discharge. The deafness is usually of the conductive or mixed type Except in extreme cases there is no relation between the size of the perforation and the degree of deafness[1] The rupture of the drum membrane seems to have a protective influence upon the inner ear

The perforation may range from a small linear tear to almost complete destruction of the drum War injuries may involve any part of the membrane, as reported by Baron[2] In most cases, there is a margin of drum between the perforation and tympanic sulcus. This is essential to healing Shrapnell's membrane is rarely injured

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Infection is a common complication Often this is present in as high as 50 per cent of war injuries, as reported by Alexander,[1] and in 20 per cent of civilian cases The common cause is infected material entering the middle ear with the causative force Another frequent cause is the indiscriminate use of ear drops and irrigations by lay and even medical attendants Korkis[2] states that in his series, 26 had had drops or syringing and that 73 per cent of these developed otitis media Of the 185 who had had no such management, 34 per cent developed infection He also states that if a chronic nasopharyngeal infection is present, a traumatic drum rupture has a 75 per cent chance of becoming infected Probably infection is prevented in some by the administration of antibiotics for other injuries If the infection is carried from the external canal, it may be less virulent than if it originates in the middle ear The type of infection may vary according to the seasonal fluctuation of bacteria[6]

Certainly, an unclosed perforation is undesirable It is a constant threat to infection from without and impairs hearing Probably numerous swimmers have drowned because of a violent vestibular reaction resulting from cold water rushing into the middle ear through a drum perforation

A high percentage of cases will close spontaneously The infected ears should be treated by thorough and frequent local cleansing in addition to sulfonamides and antibiotics locally and systemically In stubborn cases, infection in the nose, throat and sinuses should be eliminated Many believe that the primary reaction of otitis media is a stimulus to drum repair

After the infection has been absent for a few weeks and there is no reduction in the size of the perforation, it is advisable to apply a prosthesis This method is highly successful, but can be used only if the ear is absolutely dry A secretion usually floats the prosthesis off Many materials have been advocated, including cigarette paper, cargile membrane, cellophane, sheet rubber, gold foil and celluloid preparations It has been assumed that epithelium growing over the edge of the perforation prevents closure This epithelial edge is destroyed by trichloracetic acid, silver nitrate (3 to 20 per cent), or scarification A disc of sterile paper or other substance somewhat larger than the perforation is cut and applied tightly with an applicator If the paper does not completely cover the opening, a second larger piece can be put over the first. The patient is cautioned not to blow the nose and the disc is left in place a few weeks If the perforation is not closed upon its removal, the same procedure is repeated until the drum is completely healed In applying the prosthesis, an attempt should be made to straighten out any everted or folded drum fragments Folbre[5] uses cigarette paper without previous cauterization After the paper is in place, he applies trichloracetic acid to the outer surface of the paper by means of a small applicator Enough of the chemical penetrates the paper to have its effect. One advantage of this method is that the treatment is finished and lack of cooperation by the patient, due to pain of the chemical, is not important

The cauterization destroys the epithelial edge, and the artificial membrane acts as a bridge for the growth of new tissue The foreign body reaction may be helpful in healing The paper may prevent the formation of a crust at the edge of the perforation and in so doing it keeps the edges of the perforation moist so that it can heal without being obstructed by a dry crust. In addition, if the middle ear is completely closed more normal physiological conditions will prevail Application of the paper usually causes an immediate improvement in hearing and lessening of the tinnitus and also keeps out further external infection Stinson[6] believes that epithelial proliferation is the important factor causing healing, while Dunlap and Schuknecht[3] think that the intermediate fibrous layer is more important due to its contracting and stenosing action

Most cases close well with this procedure however, if the perforation extends into the tympanic sulcus, closure is almost impossible. The same method can be used on central perforations resulting from primary otitis media if no infection is present In this type of case, a fibrotic middle ear mucosa, adhesions between the eardrum and the promontory, or a badly distorted drum are likely to cause failure

In our civilian experience, we have been favorably impressed with the local use of the following prescription, three or four times a day, in the infected ear

Penicillin	Unit 75 000
Dihydrostreptomycin	gm 1
Terramycin	mg 50
Neosynephrin HCl ¼% q s ad	cc 15

The solution is warmed in a sterile teaspoon before use Local reactions to these drugs have been very uncommon with us After the ear has been dry at least a week, the edges of the perforation are carefully painted with trichloracetic acid Our prosthesis is made of ordinary prescription-pad paper sterilized in alcohol A disc of the proper size is coated lightly with Bettman's ointment and accurately applied with a very small ring curette The formula for this preparation is the following

Oxyquinoline sulphate	grains 10
Trichlorobutanol (chloretone)	grains 40
Scarlet Red N F (Biebrich s)	grains 96
Oleum Ricini (castor oil)	ounces 4

It is our practice to apply a prosthesis to all new noninfected perforations and to infected cases after the discharge has subsided and in which the healing is slow or stationary

CASE REPORTS

In the preparation of this report, I was fortunate in having access to a series of cases treated by one of my associates, Dr Lester T Jones, in a U S Naval Hospital in the United States during the last war On May 12, 1945, a defective shell exploded in a five-inch gun turret housing on an aircraft carrier None of the 13 men within this closed space was killed, but all sustained bilateral rupture of the tympanic membranes. All had burns and other injuries of various degrees and all were hospitalized immediately and received adequate early treatment to the ears Chart I summarizes the information on these cases In a few of the patients, the information is not complete because of existing circumstances

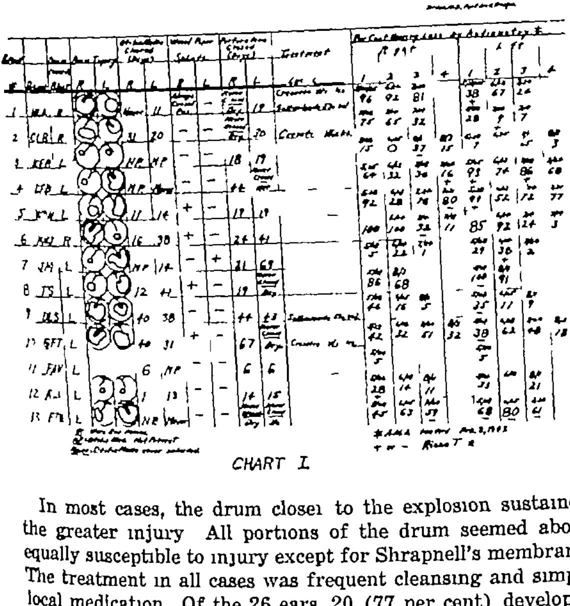

CHART I

In most cases, the drum closer to the explosion sustained the greater injury All portions of the drum seemed about equally susceptible to injury except for Shrapnell's membrane. The treatment in all cases was frequent cleansing and simple local medication. Of the 26 ears, 20 (77 per cent) developed otitis media Of this number, the infection failed to subside in only two In 19 (73 per cent) the perforations closed completely In one patient only (No 13) were both perforations left permanently unhealed Of these two ears, one remained wet and one dry Fourteen of the perforations healed spontaneously In six cases, paper splints were applied after the ears became dry but were sluggish in healing Each time

a splint was applied to the right drum of Case 1, a purulent drainage developed despite systemic sulfonamides It was assumed that an anaerobic organism was present which could not be isolated, and for this reason, the splint was abandoned In six cases, splints were not used because of the extreme size of the perforations From the information in this series, it is difficult to draw a conclusion as to the effect of infection upon healing of the drum Of the seven drums that did not close, all but one had been infected Of the 19 healed drums, 14 had been infected

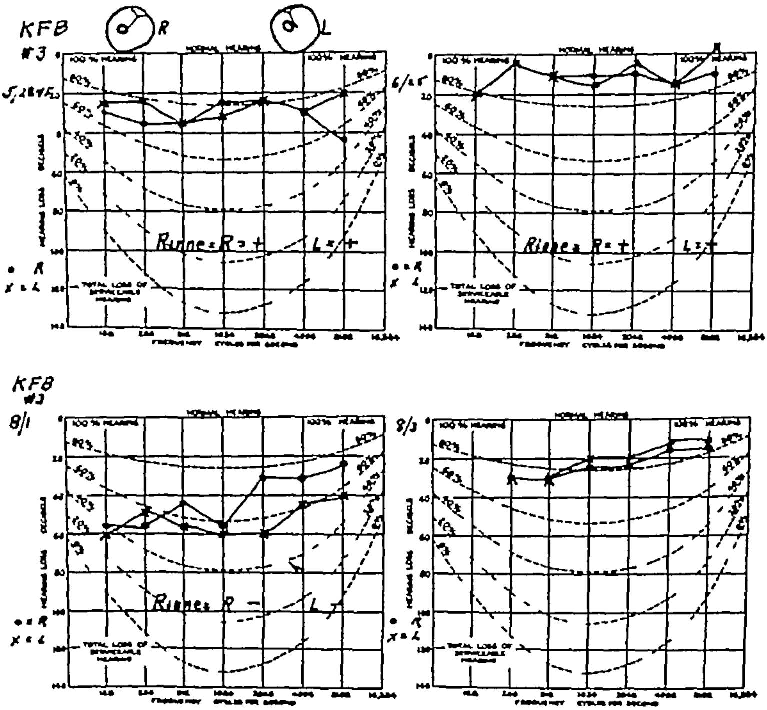

CHART II

All patients had tinnitus of varying degree, and as far as was known, this symptom disappeared in all The percentage (A M A) of hearing loss as shown by the audiometer varied

considerably In 10 of the 13 patients, the original test showed a greater loss in the ear closer to the explosion In 10 of the cases the final test was also worse in the ear nearer to the blast. Since most of the cases had a relatively flat audiometer curve with positive or negative Rinne tests, it was assumed that the loss was of the mixed type with a predominance of the nerve factor Bone conduction audiometry was not available. In 13 ears, or 50 per cent, the hearing became worse

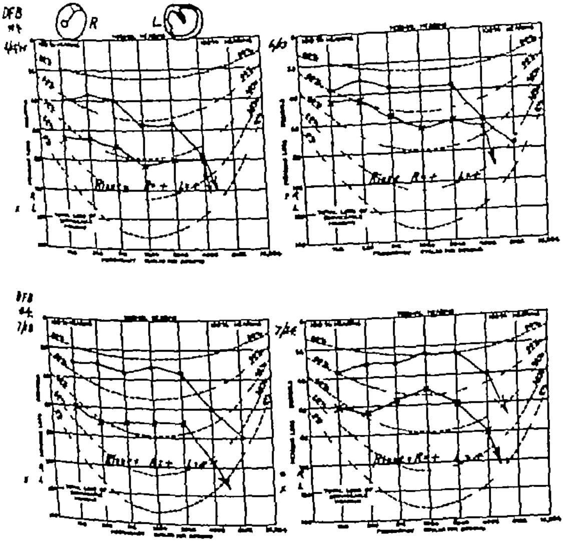

CHART III

after a few weeks In all but two of these cases, the hearing improved to the original or better level in the following weeks In all but three ears the last audiometer test was better than the first. No relation between this variation and middle ear or drum behavior could be proven

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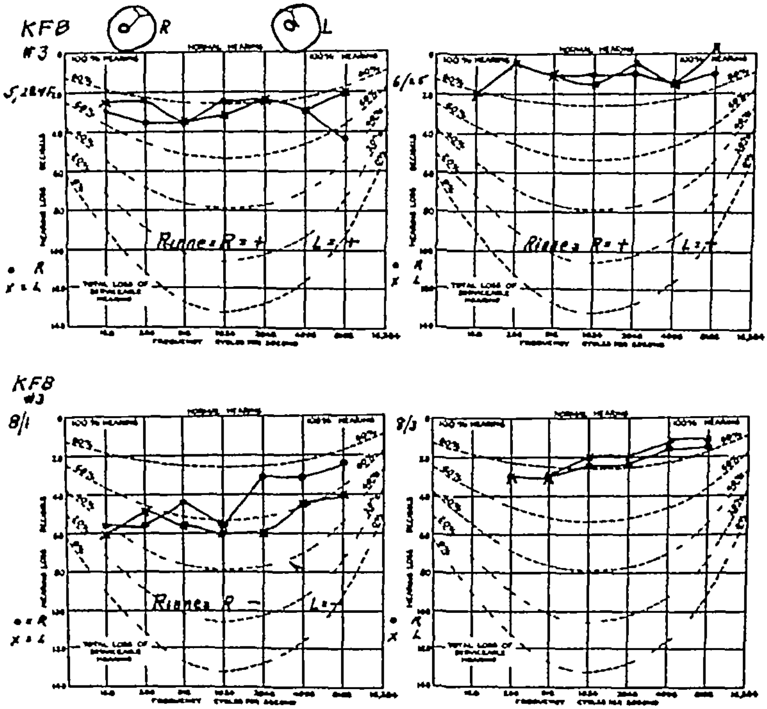

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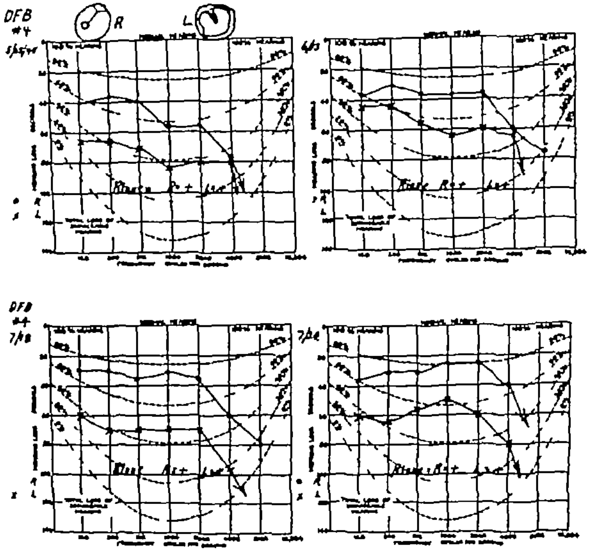

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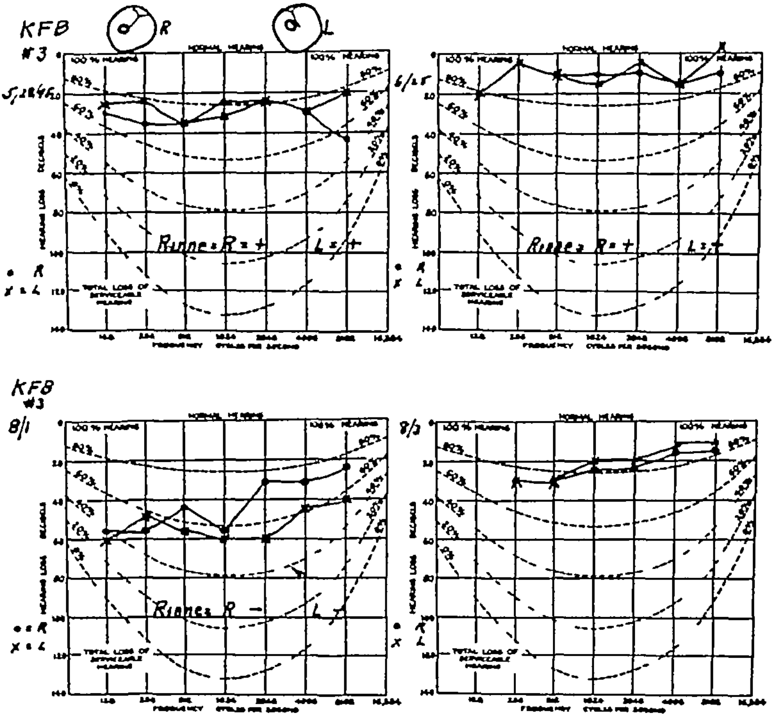

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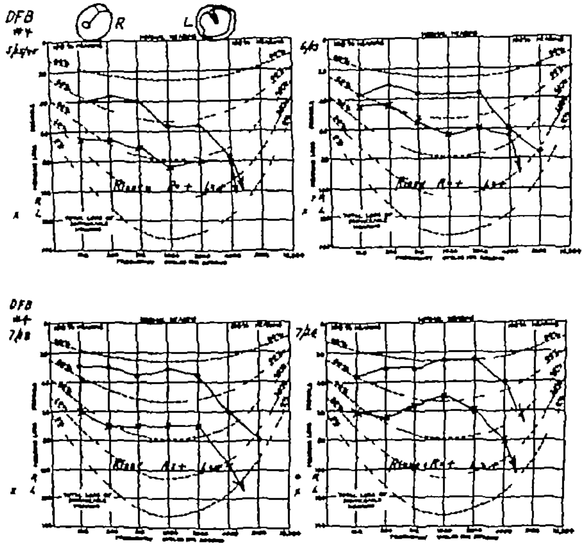

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In the final examination, six men of the original 13 had permanent perforations of the drums Originally these ruptures had all been large Of these men, five had one drum completely healed In only one (Case 13) were both drums unhealed permanently, one wet and one dry The audiometer curves of Cases 3 and 4 are shown (see Charts 2 and 3)

SUMMARY

Traumatic rupture of the tympanic membranes is discussed A series of 13 patients is presented, in which all drums were ruptured by one explosion

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GLOMUS JUGULARIS TUMOR OF THE MIDDLE EAR

(Carotid Body Tumor Tympanic Body Tumor Nonchromaffin Paraganglioma) *†

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New York, N Y

In 1945, the author[1] described a tumor which filled the middle ear and extended into the mastoid process in the absence of any demonstrable involvement of the carotid body in the neck At that time, I quoted a brief communication by Guild[2] which was of extreme timeliness and interest in that it provided a morphologic explanation for the presence of what our pathologist, Dr Otani, felt was a carotid body type tumor Guild's report published in 1943 is of sufficient importance to warrant its restatement

> Human temporal bone sections reveal structures in several respects like the carotid body for which the name glomus jugularis is proposed. Usually they are in the adventitia of the dome of the jugular bulb immediately below the bony floor of the middle ear and near the ramus tympanicus of the glossopharyngeal nerve Usually there is but a single flattened ovoid glomus about 0.5 mm. in the long diameter and about 0 25 mm. thick Occasionally two or more smaller bodies are present. Sometimes one or all are in the canal that transmits the ramus tympanicus through the floor of the middle ear (in one case also along the course of this nerve over the cochlear promontory) Each glomus wherever located consists of blood vessels of capillary or precapillary caliber with numerous epithelioid cells between the vessels—innervation and blood supply come from the same trunks that supply the carotid body namely glossopharyngeal nerve and ascending pharyngeal artery through its inferior tympanic branch.

Since then there have been numerous reports in the literature describing cases either newly recognized or composed of old cases restudied in the light of somewhat altered pathologic concepts As stated by Winship,[3] certain primary tumors of the middle ear heretofore have been designated as endo-

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†From the Otolaryngological Service the Mount Sinai Hospital New York.

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theliomas and hemangioendotheliomas These diagnoses often have been made by the process of exclusion and some uncertainty has been felt regarding the accuracy of these designations

Le Compte, Sommers and Lathrop,[4] in 1947, described a tumor of carotid body type arising in the middle ear This report was followed very shortly by a communication by Kipkie,[5] which recounted the finding of simultaneous tumors involving the carotid body on the right side and the glomus jugularis on the left side Winship, Klopp and Jenkins,[3] in 1948, described what they felt was the first instance of a malignant metastasizing glomus jugularis tumor Their report contained the first review of the available cases and a restudy of some of the cases which had previously been diagnosed as endotheliomas and hemangioendotheliomas This report was a timely one and represented much studious effort and application

Lundgren,[6] in 1948, very thoroughly reviewed the literature, added four cases of his own and briefly discussed nine other cases previously described by other authors under varied terminology These nine cases form the subject matter of a re-evaluation from the pathologist's standpoint and form the basis of a report by Berg Of extreme interest to me was the fact that three of the four cases described by Lundgren were discovered in patients with intact though bulging drums

In September, 1951, Brown[8] reported an almost similar case to the above mentioned cases of Lundgren In this instance, also, the patient had an intact bulging drum and complained of severe pulsating tinnitus in the right ear Myringotomy resulted in severe bleeding A radical mastoidectomy was performed The middle ear was filled with tumor tissue The floor of the hypotympanum was intact, with no apparent communication of the tumor with the jugular bulb

Lattes and Waltner,[9] in 1949, in an excellent report, replete with beautiful histologic sections, described eight additional cases from the material of the laboratory of Surgical Pathology and Department of Otolaryngology of the College of

Physicians and Surgeons They suggested that these tumors, which had been referred to as carotid body tumor (Rosenwasser), glomus jugularis tumor (Winship Klopp and Jenkins), tympanic body tumor (Lundgren), be designated as nonchromaffin paragangliomas of the middle ear, and gave their reasons quite logically for this suggested designation. Bartels,[10] in 1949, published an excellent monograph with a complete review of the literature Of the many things of interest he mentioned were three separate instances of carotid body tumors occurring in more than one member of the same family

There have been isolated case reports by Fuller[11] (1949) De Lisa[12] (1950), Lewis and Grant[13] (1951) Winship and Louzan[14] (1951), Poppen and Riemenschneider[15] (1951) (two cases) and Dockerty, Love and Patton[16] (1951) In the recent report of Winship and Louzan,[14] they recorded an additional case They suggested that tumor had its origin from the glomus on the inner tympanic wall in the presence of an intact hypotympanum They summarized the literature almost up to date with a brief resume of 42 cases however, I am aware from personal communications of additional cases as yet unrecorded in the literature, by Arnold, Coe, Lester Brown and others, which will augment a growing literature

I was impressed with the discussion of Dockerty, Love and Patton,[16] who in an effort to cast some light on this subject and find a descriptive term which perhaps best describes this unusual middle ear tumor, stated that up to recently there were investigators who believed that the carotid body and allied structures, including the glomus jugularis, were true paraganglioma and had the same derivation as the adrenal medulla, hence, it was never really understood why the carotid body tumors did not elaborate adrenin as did similar adrenal tumors namely the pheochromocytomas

Le Compte[17] and others have pointed out that the reaction indicating chromaffinity which was claimed to be a cellular characteristic common to the structures mentioned, was indeed nonspecific furthermore, the chromaffin reaction while strongly positive in the adrenal medulla, often is doubtfully positive or more usually negative in preparations of the carotid body. The experiences of Otani are in substantial accord with this statement. Le Compte[17] quotes De Castro, an investigator, who questioned the existence of a true chromaffin reaction in the carotid body, declaring that the apparent reaction was due to the presence of lipoid substances in the cells. This conclusion was largely confirmed by Hollinshead, who felt that the cytoplasmic granules were not lipoid in nature but might be mitochondria. Le Compte's opinion, in the light of present knowledge, was that the carotid body should be classified as a specialized chemoreceptor and not as a gland of internal secretion, paraganglion or arteriovenous glomus. It is obvious from the above that there still is not complete accord as to the function of the carotid body in the neck. It can be fairly stated that there is still much to be ascertained as to the classification and function of those similar smaller structures found in the dome of the jugular bulb, inner tympanic wall and in relation to the facial nerve, which so closely resembles histologically the carotid body in the neck.

Lattes[18] quotes Waska,[19] who suggested that paraganglioma be divided into chromaffin (epinephrine producing paraganglionic tissue) and nonchromaffin (nonepinephrine producing paraganglionic tissue). It is further suggested that the latter is the type usually associated with the cranial nerves.

Guild,[20] in discussing an excellent presentation by Weille and Lane, Jr.[21] (1951), stated that recently he noted glomus formations occurring along the course of the nerve of Arnold (auricular branch of the vagus nerve) as well as along the course of the nerve of Jacobson (tympanic branch of the glossopharyngeal nerve). Typical glomus formations were seen along the nerve of Arnold as far distal as to that point where it crossed the descending part of the facial nerve. It has been pointed out by Lundgren that glomus formations similar to those described by Guild have been the center of much discussion in the anatomic literature as far back as 1840, when Valentin described a slight swelling around the *tympanic nerve, which he termed ganglion tympanicus* In 1878, Krauss described the similarity between what he called the glandula tympanica and the glandula carotica

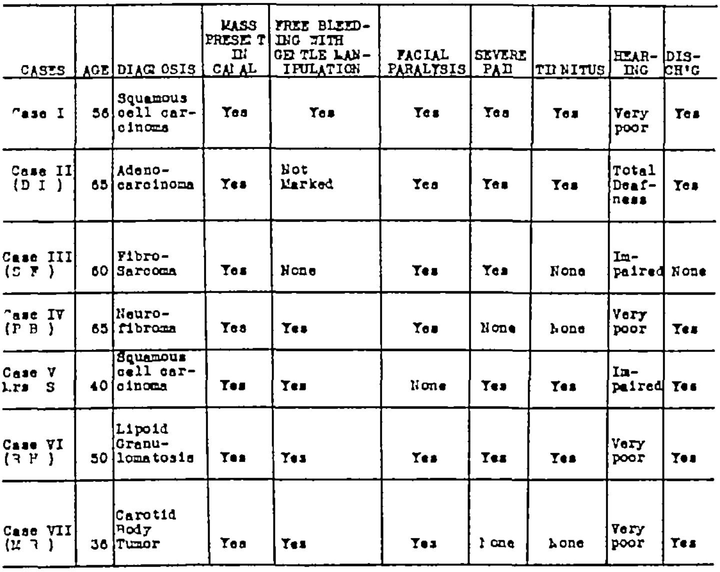
The practical significance of the finding of glomus like formations in the aforementioned additional locations readily explains the early involvement of the facial nerve in some cases and the absence of involvement in others depending upon whether or not the origin was from the inner tympanic wall anlage or from a glomus situated in the floor of the middle ear or in close relation to the jugular bulb or facial nerve

In the discussion of Weille and Lane's paper, mention was made of additional instances of carotid body tumor by Hoople[22] (three cases), Walsh[23] (four cases) and Miller[24] (one case) The case described by Miller was similar to one of the cases reported by Weille and Lane, Jr, in that the tumor destroyed the petrous bone and eroded through the naso pharynx. Fortunately, this is an uncommon occurrence I am certain that many critical reviews and re-evaluations of vascular tumors of the middle ear are currently under way, and in the not too distant future many additional reports of carotid body tumor, glomus jugulare tumor, tympanic body tumor or nonchromaffin paraganglioma will be recorded

In the clinical reports of these tumors there have been noted certain oft repeated symptoms and this has resulted in a tendency, on the part of some, to ascribe specificity of symptoms to these tumors I am in accord with the attitude expressed by Lattes and Waltner and others that most of the symptoms presented by patients with these tumors are non specific, and may be observed in any instance in which the external auditory canal or middle ear is gradually obstructed by an expanding tumor

In 1940, I[25] wrote a paper entitled ' Neoplasms Involving the Middle Ear " in which the symptoms and signs manifested by these neoplasms a squamous cell carcinoma, an adenocarcinoma, a neurofibroma and a fibrosarcoma, were included in a table Also included in the table is carotid body tumor, a case of lipoid granulomatous and an additional squamous cell carcinoma Carotid body tumors are richly vascular, and this explains the tendency to bleed upon gentle manipulation, to a degree perhaps greater than with other tumors, however, bleeding has been a manifest clinical symptom in many different types of tumor involving the middle ear and mastoid bone (see Fig 1) As noted in the table, the presence of pain, facial paralysis, impaired hearing and tinnitus are fairly constant findings, particularly in the late stages of the disease of all these tumors Severe tinnitus has been a fairly consistent symptom it seems, before the tumor causes destruction of the drum membrane, and this is easy to understand The tendency for so-called aural polypi or granulomata with associated chronic middle ear suppuration to present protean symptomatology is too well known to dwell upon

ANALYSIS OF SYMPTOMS MANIFESTED BY DIFFERENT TYPES OF NEOPLASMS INVOLVING MIDDLE EAR AND MASTOID



CASES	AGE	DIAGNOSIS	MASS PRESENT IN CANAL	FREE BLEEDING WITH GENTLE MANIPULATION	FACIAL PARALYSIS	SEVERE PAIN	TINNITUS	HEARING	DISCH'G
Case I	56	Squamous cell carcinoma	Yes	Yes	Yes	Yes	Yes	Very poor	Yes
Case II (D I)	65	Adeno-carcinoma	Yes	Not Marked	Yes	Yes	Yes	Total Deafness	Yes
Case III (S F)	60	Fibro-Sarcoma	Yes	None	Yes	Yes	None	Impaired	None
Case IV (P B)	65	Neuro-fibroma	Yes	Yes	Yes	None	None	Very poor	Yes
Case V Mrs S	40	Squamous cell carcinoma	Yes	Yes	None	Yes	Yes	Impaired	Yes
Case VI (R P)	50	Lipoid Granulomatosis	Yes	Yes	Yes	Yes	Yes	Very poor	Yes
Case VII (M R)	36	Carotid Body Tumor	Yes	Yes	Yes	None	None	Very poor	Yes

Fig 1

It is generally accepted that the gross appearance of the tumor does not present characteristics sufficiently definite to enable one to make a diagnosis clinically This is particularly true in those instances in which there is associated middle ear suppuration with attendant acute or subacute inflammation, with its alterative inflammatory effects upon the underlying tumor I am intrigued with the reports of the cases of Lundgren in which the patients were operated upon before the tumor had had the opportunity to enlarge and erode through the drum or Fallopian aqueduct. In one instance (Case 1) the patient did not have facial paralysis or pain It is easy to understand why this expanding space-filling mass in the middle ear cavity was accompanied by roaring tinnitus and deafness Three of the four cases presented by Lundgren had almost identical signs and symptoms In the instances in which myringotomy was performed the persistent bleeding which ensued from the opened middle ear was of clinical diagnostic significance

In the instances in which a tumor mass presents in the ear canal accompanied by aural discharge, I have not been impressed with the occurrence of tinnitus of a pulsating type in sufficiently high percentage of the cases to feel that this symptom is of any special diagnostic significance

It has been stated that similarity in the appearance of the bone defects have been noted in Roentgenograms of the petrous pyramid and mastoid bones in proven cases of glomus jugularis tumors I suppose it is not illogical to expect that tumors originating on the inner tympanic wall or from the floor of the middle ear, slowly expanding, might at a proportionate period of their growth conceivably produce comparable bone defects As a clinician, I am somewhat loathe to attempt a specific diagnosis as to the nature of a tumor from the type of bone defect observable Roentgenologically

PATHOLOGY

From the histopathologic standpoint, there is noted in the analysis of the reports in the literature considerable repetitive uniformity in the morphologic characteristics of these tumors The groups of tumor cells are bordered by capillaries and tend to form alveolar structures This alveolar arrangement of the neoplastic cells is not always distinct In some places the cells take the form of compressed cord-like structures (see Fig 2)

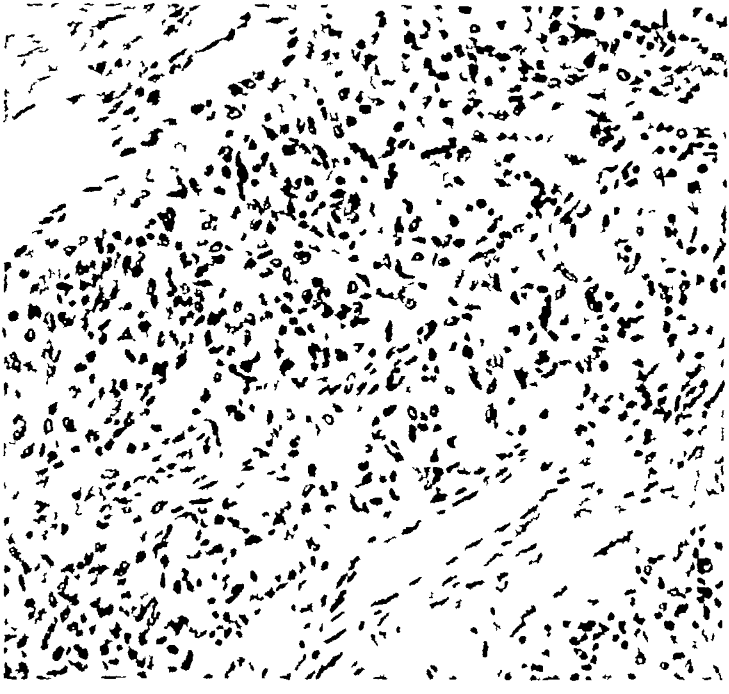


Fig 2 A representative area of the tumor from the tympanic cavity Note the characteristic tumor cells in groups like nests separated by dense fibrous tissue stroma The empty spaces indicate the extremely vascular nature (×275)

The cells usually are large and polyhedral The nuclei are small and not hyperchromatic The abundant cytoplasm is frequently vacuolated This vacuolization obscures the cell outlines in many instances There often is considerable uniformity in the oval shape of the nuclei, although there may be areas in the tumor in which the tumor cell nuclei vary in shape Mitotic figures were not noted in our original report, nor has its occurrence been noted with any frequency in the many subsequent reports to date I would like to point out the identical histologic features in Fig 3 a section made from a typical carotid body tumor in the neck when compared with the tumor section from the tympanic cavity (see Fig 2)

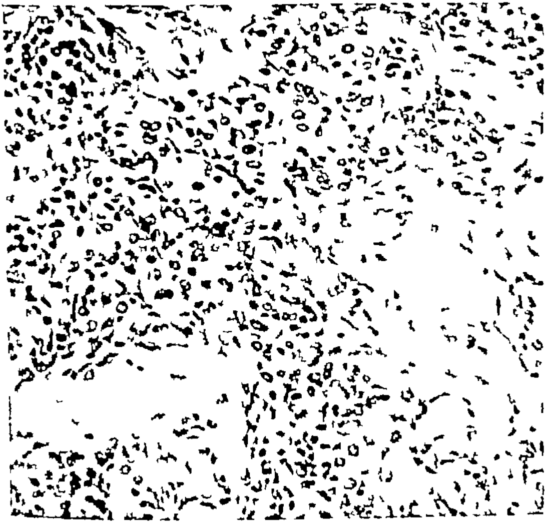


Fig 3 A representative area of a typical carotid body tumor removed from the neck. Note the characteristic tumor cells in nests separated by dense fibrous tissue stroma and the vascular nature of the tumor The identical histologic features of this tumor and the tumor in Fig 1 are notable (× 75)

TREATMENT

The treatment of this entity is surgical When the tumor originates from the glomus structures on the inner tympanic wall and if operated upon before widespread erosion takes place, it is quite possible to completely eradicate the tumor Instances of this type have been described by Lundgren and others and support this contention If the tumor arises from the glomus jugularis in the floor of the middle ear and erodes through the bony floor and intimately involves the jugular bulb, it poses a far more serious surgical problem There have been differences of opinions expressed as to the wisdom of ablation of the bulb in view of the inherent risk in the surgery involved When one considers the known slow growth of the tumor and the relative rarity with which metastasis occurs, it may lend some support to this conservative attitude If the tumor arises from glomus structures in close proximity to the facial nerve with early onset of facial paralysis it may necessitate removal of part of the facial nerve to remove the tumor This must, of course, be combined with some type of facial repair, perhaps the short-circuiting type of facial nerve repair advocated by Lempert

In the surgical treatment of these tumors, hemorrhage at times of considerable severity must be anticipated Adequate measures to replace blood loss with transfusions and other supportive measures should be readily available It is becoming increasingly apparent from the available opinions expressed that radiation even as administered today, unaccompanied by surgery, offers little of encouragement Generally speaking, the earlier in the course of the disease one encounters this condition, the more likely is the chance for complete removal, and obviously, the better the ultimate prognosis Because of the known slow growth of these tumors, there must be a prolonged follow-up before one may be assured of complete cure

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MODIFIED RADICAL ANTROTOMY *†

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San Francisco, Calif

Surgical treatment of the maxillary sinuses is not often necessary It should be reserved for those cases of chronic purulent maxillary sinusitis which have drainage deficit This diagnosis is properly made in cases in which there is definite objective proof of chronic bacterial infection of the mucous membranes It should never be made on the basis of symptoms alone, such as chronic postnasal discharge, nor should it be made by Roentgenograms alone because similar shadows may be cast by vasomotor congestion due to allergic, metabolic, psychosomatic or other causes On the other hand, the unvarying finding of true pus in the wash returns of antrum irrigations at repeated, adequately spaced intervals, is a pathognomonic sign of true chronic bacterial infection with drainage deficit In such instances cultures and antibiotic sensitivity tests are desirable preludes to a thorough trial of combined irrigation therapy and appropriate chemotherapy in these cases If complete cure is not thus obtained, surgery is advisable

A word regarding incidence The disease is relatively uncommon in spite of the fact that the diagnosis is made with cheerful abandon by laymen and unqualified professionals alike The author's own records disclose approximately 2,500 separate patients over a period of 12 years who specifically complained of symptoms referable directly or indirectly to the nose or sinuses These symptoms included so-called sinus headaches, postnasal drip, nasal congestion, rhinorrhea and sneezing, facial pressure sensations, acute sinus infections,

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et cetera From this entire group of approximately 2,500 individuals the author was able to make a diagnosis of chronic purulent sinusitis with drainage deficit in no more than 35 cases Thus, it can be seen that if the disease is present in about 1 to 2 per cent of individuals who have specific nasal complaints the natural conclusion would be that the percentage of incidence is much lower in the populace at large

Surgical therapy should be considered in chronic maxillary sinusitis only when there is a drainage deficit, or in other words, a constant pooling of pus If ciliary activity is capable of clearing pus exuded from inflamed mucous membranes there is likely to be no benefit obtained by creating auxiliary gravitational drainage facilities because these would be ignored by the ciliary stream Likewise, extirpation of abnormally appearing mucous membranes in antrums without drainage deficit does not always offer a permanent solution because the membranes which subsequently replace them too frequently become infected because they regenerate from contiguous areas which are also usually infected in varying degrees These cases of chronic bacterial sinusitis without drainage deficit are best treated by systemic chemotherapy and hygienic measures

In the past there has been two schools of thought regarding maxillary sinus surgery some rhinologists prefer intranasal surgery but are willing to use the so-called radical or sublabial approach in selected instances, others feel that the sublabial approach is the one of choice for most cases In the earlier years of the author's practice the intranasal approach was favored whenever possible because it appeared to be the most conservative method of achieving the objective of adequate drainage The fact that so many cases could be cured by this simple procedure made it seem likely that a more precise method of making the intranasal window should appreciably increase the percentage of cures In this respect it must be admitted that the sublabial approach offers several obvious advantages With it, the creation of the nasoantral window can be executed with much finer surgical precision In addition it allows ideal circumstances for definitive inspection of the sinus cavity One is thereby far less likely to miss a foreign body or an early malignancy, furthermore, minor procedures such as extirpation of a polyp or removal of a biopsy specimen can be performed with far greater ease than through the nose

Thus far, it is obvious that nothing more has been said than Caldwell and Luc reported many years ago The entire thesis of this article rests on one important difference in technique, made possible by the antibiotic medications of our modern era The mucosal lining of the antrum is carefully preserved in all cases even though the sublabial approach is used Hence, the outstanding conservative feature of the intranasal approach is maintained

After sublabial exposure of the antrum lumen, it is common practice among rhinologists to inspect the cavity and then proceed in one of two manners If the lining looks almost normal the surgeon usually preserves it and contents himself with the creation of a good nasoantral window On the other hand, if the lining looks at all bad *i e*, edematous or eroded, the operator usually removes the entire antral mucosa before creating the nasoantral window When the mucosal lining is thus entirely removed (see Fig 1B) the pattern of healing is by secondary intention, comparable to the process which occurs when a large area of skin and subcutaneous tissue is lost over a bone area on the body surface, leaving a large gap for the skin to bridge As a part of the process of healing by secondary intention after radical antrotomy, granulations begin to appear after a few hours on the denuded bone surfaces At the same time, mucosal epithelium begins to extend toward the antrum walls by proliferation from cut edges of nasal mucosa in the region of the natural ostium and the newly created inferior meatus opening The extent of the gap (see Fig 1B) is so great that the extension of epithelial growth cannot keep up with the development of granulation tissue (see Fig 2A) The latter becomes quite exuberant and may nearly fill the antrum lumen, yet, surprisingly, in a large percentage of cases, the healing is completed in a much shorter time than could be expected by extension of the nasal

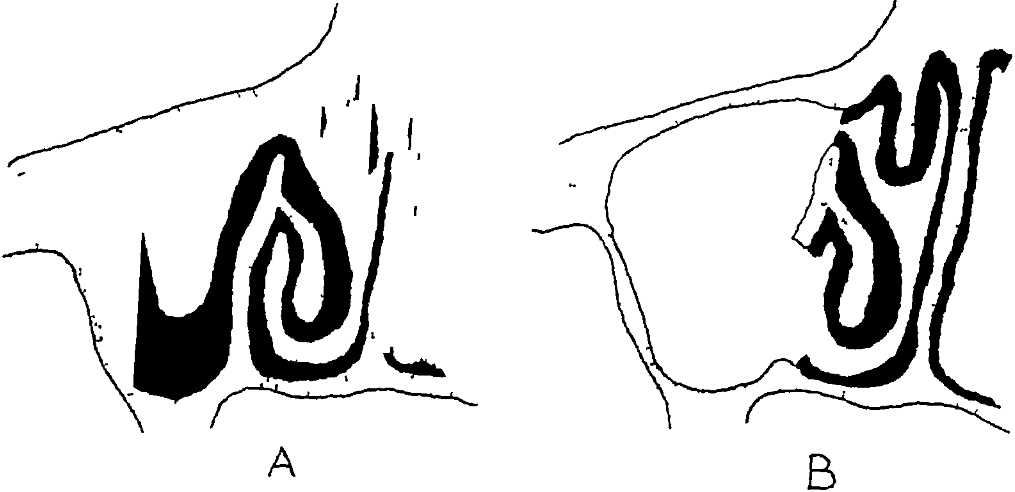

Fig. 1 (A) Diagrammatic section showing thickened mucosa of chronically infected antrum (B) *The standard procedure* in classical radical antrotomy includes *complete extirpation of diseased* mucosa as well as creation of inferior meatus window A gap as *long as* 7 cm is left for *the mucosa* to bridge in order to effect healing

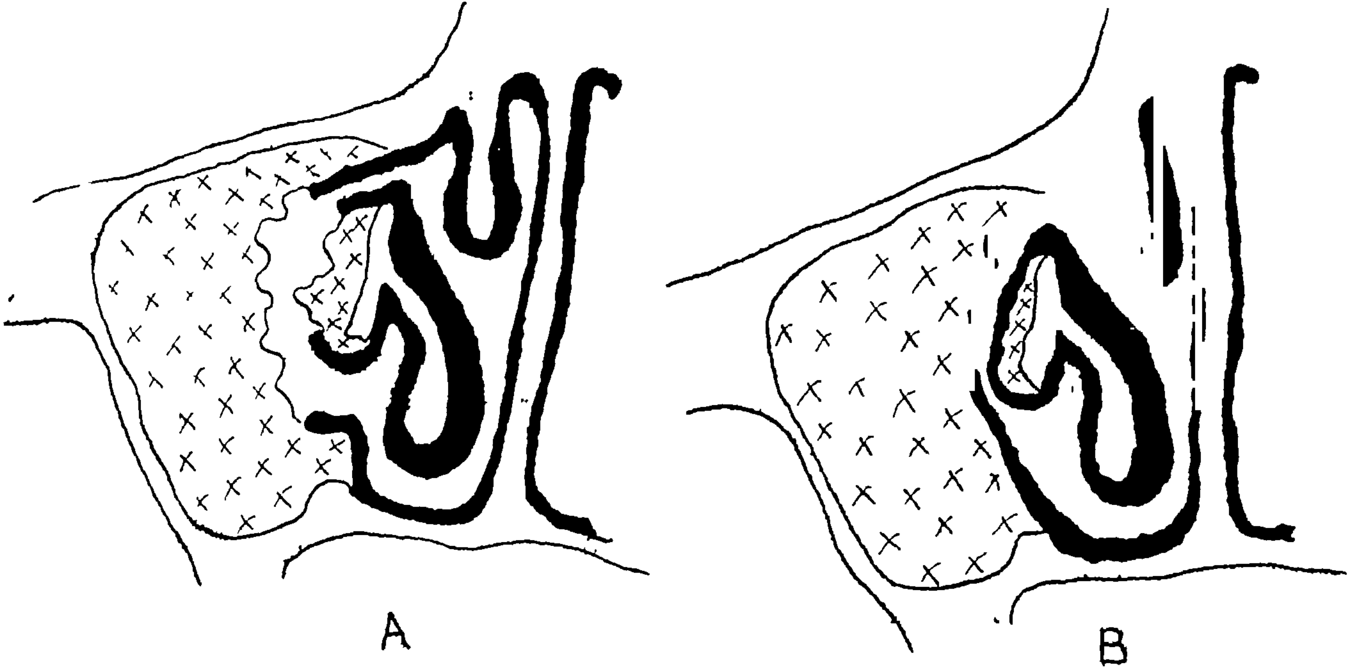

Fig 2 (A) Process of healing after complete extirpation of antral mucosa is one of secondary intention Granulations depicted by crisscrossed area arise from the denuded bone surfaces Nasal mucosal epithelium extends toward the antral walls from the region of the natural ostium and from the newly created inferior meatus opening (B) Rapidity in healing time after standard radical antrotomy is largely due to the granulations causing a shortening of the distance needed to be traversed by extending mucosal edges in order to effect a sealing juncture

mucosa around the entire antrum circumference In the past this rapidity of bridging has been credited to epithelium proliferating from mucosal islands in the grossly denuded bony wall however, observations with a nasopharyngoscope during the early postoperative period indicate that the reduction of healing time may be in large part due to the part played by the granulation process in causing a shortening of the distance needed to be traversed by the extending mucosal edges in order to effect a sealing juncture (see Fig 2B) Thereafter, this same granulation tissue begins to change in classical manner into fibrous tissue. The shrinkage associated with this change causes marked retraction toward the bony walls of the antrum with the result that the newly sealed mucosal surface is also drawn laterally (see Fig 3A) The mucosa thus severely stretched and thinned may play a part in the irregularity and incompleteness of the retraction process, so that subsequent examinations by antroscopy or by Roentgenograms rarely show other than a distorted sinus lumen In some cases, granulation synechiae may cause the creation of two sinus cavities (see Fig 3B) Many of these cases do very well after surgery in spite of this distortion, but unfortunately a disturbing percentage are prone to frequent recurrent infections

Normal sinus mucosa is capable of a considerable range of erectile excursions as a response to various physiological stress conditions The new retracted and thinned mucosa of the classical radical antrotomy with its fibrous bed has a greatly reduced capacity for such excursions As a result, there are not infrequently varying degrees of annoying postoperative neuralgia like symptoms which may be due to inability of the membranes to make a natural adjustment when such stress conditions prevail

The conservative sublabial operation advocated by the author is based on the proven fact that the mucous membrane lining of the antrum has amazing recuperative powers In spite of the miserable appearing condition it may present in some cases, proper treatment converts this mucous membrane into a lining which is superior in appearance and physiologi-

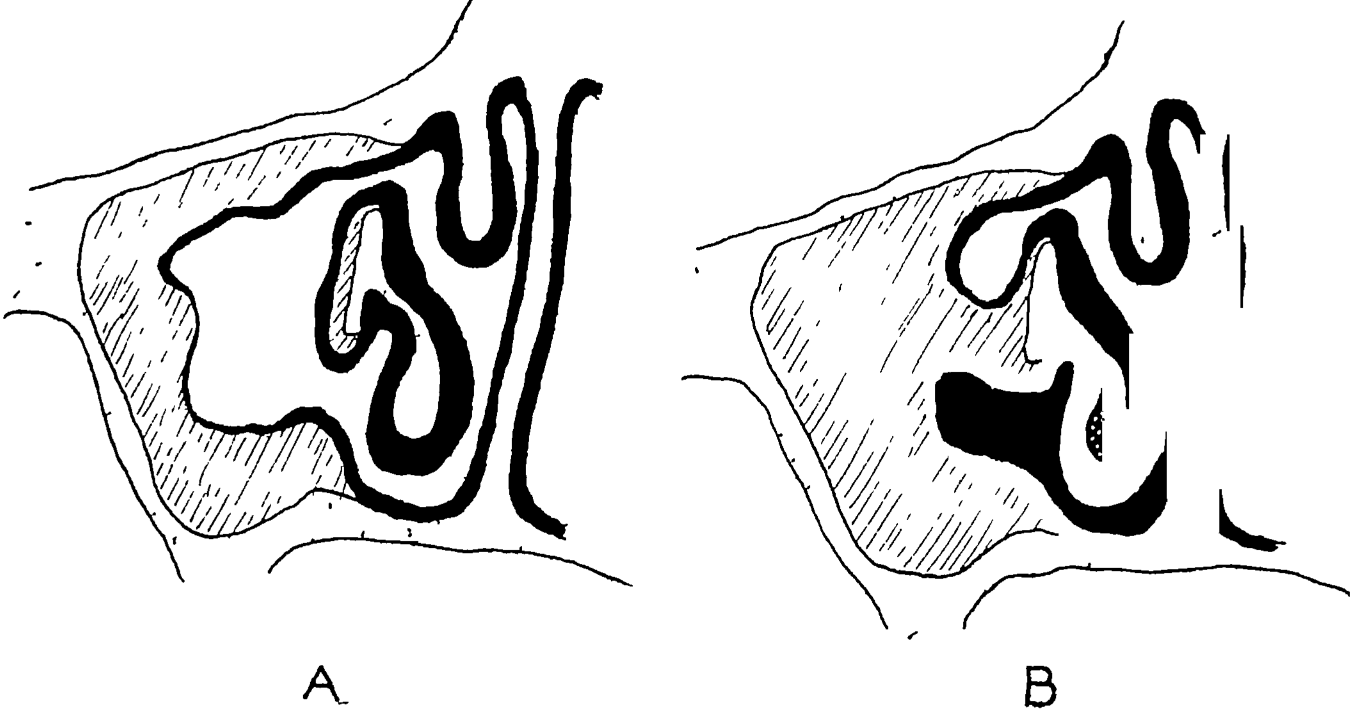

Fig 3 (A) The shrinkage associated with the conversion of granulation tissue into fibrous tissue causes marked retraction toward the bony antral walls with the result that the newly sealed mucosal surface is also drawn laterally The mucosa thus severely stretched and thinned may play a part in causing the irregularity and incompleteness of the retraction process Subsequent Roentgenograms or antroscopy usually demonstrate a distorted sinus lumen (B) In some cases granulation synechiae may cause the creation of two sinus cavities

cal function to that which replaces the completely extirpated lining The procedure is as follows After routine exposure of the antrum lumen through the canine fossa opening the purulent secretions present are removed with suction Advantage is taken of the excellent exposure to inspect the cavity carefully Discrete polyps, cysts and pyoceles are carefully treated by excision or incision, with care not to injure surrounding tissues Appropriate specimens, if any, are sent for histological study Beyond this, with the exception of that necessary to create the nasoantral window, no membrane lining is removed This includes eroded mucosa, markedly edematous mucosa and mucosa studded with cysts or pyoceles The latter two are marsupialized by removing the presenting surfaces of the lesions with a ring punch (see Fig 4) Special attention is then directed to the creation of a nasoantral window with size and shape of predictable permanency This is accomplished by first removing a piece of antral mucosa about 1 cm in diameter, followed successively by similar sized sections of opposing bone and inferior meatus mucosa (see Fig 5) Following this the mucosa on either side of the bone

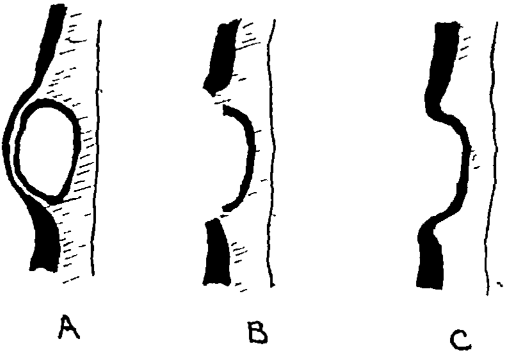

Fig. 4 The modified radical antrotomy could be termed radical only because of the sublabial approach. No membrane lining is removed with the exception of that necessary to create the nasoantral window Cysts and pyoceles are marsupialized by removing the presenting surfaces with ring punch (A) with subsequent healing as depicted in (B) and (C)

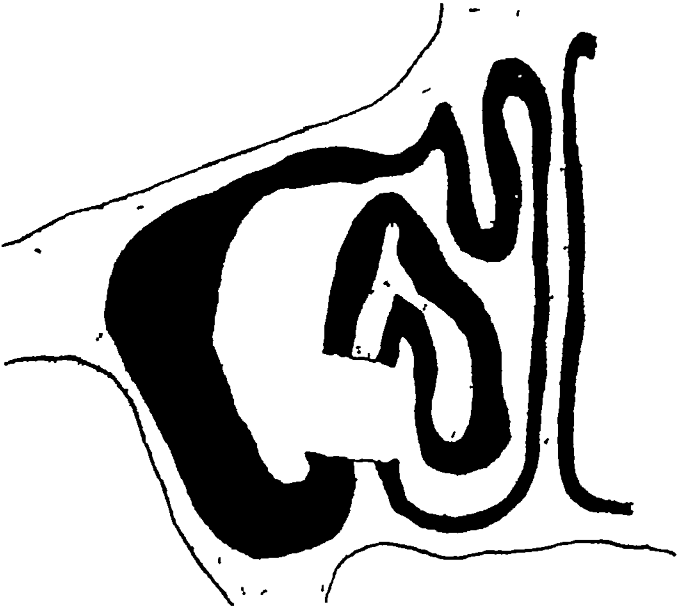

Fig 5 First stage of creation of nasoantral window with size and shape of predictable permanency The turbinate is in no way disturbed

edge is elevated to a distance of about 3 mm (see Fig 6A), after which the thin plate of bone sandwiched between is submucously resected (see Fig 6B and 6C) This is accomplished with relative ease on all but the anterior edge (see Fig 7A) For this portion the following technique is used The antral mucosa is first incised diagonally in the anterior superior and inferior corners and thereafter elevated forward (see Figs 7B and 7C) The bone edge thus exposed is then bitten off with Hajek forceps (see Fig 7D), bringing into view the tented edge of the inferior meatus mucosa The antrum mucosa is then flapped back against the latter (see Fig 7E) It is also best not to have the lower edge of the window too close to the floor of the nose Here the bony partition becomes too thick to allow accurate performance of the submucous procedure The purpose of this surgical refinement is as follows The submucous resection allows the mucoperiosteal surfaces of the antral and nasal linings to make

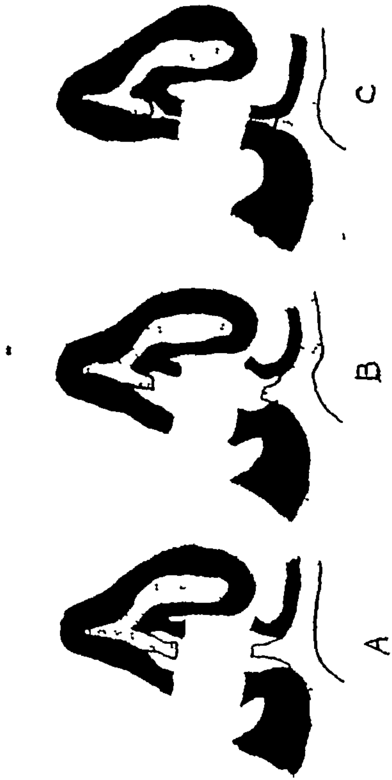

Fig 6 Second third and fourth stage of creating the inferior meatus window The mucosa on either side of the bone edge is elevated to a distance of 3 mm. after which the thin plate of bone sandwiched between is submucously resected This allows the muco periosteal surfaces of the antral and nasal linings to make contact in an everted manner

contact in an everted manner This is a basic principle in good surgical practice of joining epithelial surfaces to encourage healing by first intention A window of this type heals with little or no interference from granulations, maintains its original size, has knife-like edges when healed, and has as little chance of closing as does a postoperative septum perforation of the same size

The turbinate is in no way disturbed It is not advisable either to push it toward the septum or to amputate its anterior tip

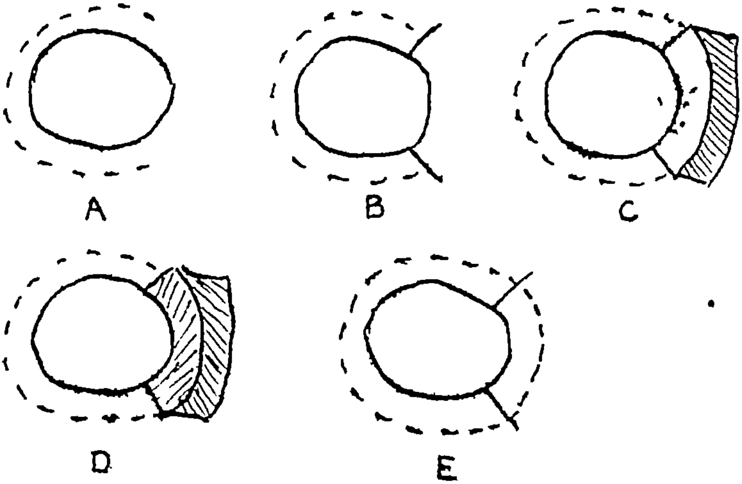

Fig 7 Submucous resection of the inferior meatus window as shown in Fig 6 is accomplished with relative ease on all but the anterior edge In this portion the following technique is used The antral mucosa is first incised diagonally in the anterior superior and inferior corners (A) and thereafter elevated forward (B C) The bone edge thus exposed is then bitten off with Hajek forceps (D) bringing into view the tented edge of the inferior meatus mucosa The antrum mucosa is then flapped back against the latter (E) It is best not to have the window too close to the floor of the nose Here the bony partition becomes too thick to allow accurate performance of the submucous procedure

The author has performed the modified radical antrotomy on 17 consecutive cases of true chronic antrum infection in this manner over a period of eight years Many of the cases in this series had mucous membrane linings which appeared to be in very poor condition Concomitant surgical procedures were performed when indicated These included submucous resection, intranasal ethmoidectomy, and removal of nasal polyps, both mucus and granulation type Empirical systemic chemotherapy was administered intensively in all cases for about five days after surgery The average hospital stay was three days after operation Discomfort during this period appeared considerably less than that experienced after extirpation of 15 to 20 sq cm of antral mucosa. Postoperative antrum irrigations were omitted in most cases. In others, it was done infrequently and then primarily for the purpose of evaluating the progress of healing. Frequent examinations with a nasopharyngoscope demonstrated uniformly rapid healing in the region of the inferior meatus opening by primary intention due to the proper apposition of mucosal edges. The same instrument showed the walls of the cavity to be surprisingly smooth in most cases. X-ray examination after several months demonstrated normal or varying degrees of thickened mucosa with relatively little distortion of lumen shape. Normal ciliary pathways and capacity for erectile excursion were not disturbed because the lining was not extirpated. This may account in part for the fact that no disturbing neuralgias or persisting unpleasant sensations occurred in any of the cases in this series. Further studies with a nasopharyngoscope after surgery indicate that the inferior meatus opening serves only in auxiliary capacity to drain unwieldy masses of secretions during the postoperative healing stage and during any acute flareups which might occur after healing is complete. Proof of this was obtained by postoperative experiments on several cases in which the membrane had been preserved even though apparently in extremely poor condition. India ink placed into the antrum clearly indicated that the ciliary function carried debris to the natural ostium rather than to the more dependent and much larger operative opening.

The principle here outlined is not new. The small series presented may be unique, however in that the cases were consecutive, entirely unselected and every phase of infection severity was encountered. One of the cases in the series is an allergic individual who still develops recurrent acute attacks of bacterial infection in the operated antrum several times a year. Response in this case is rapid to antrum irrigation combined with systemic chemotherapy. In the rest of the series, the modified radical antrotomy as described resulted in unequivocal healing with surprisingly few subsequent acute attacks. Observation of this group has reinforced the confidence of the author in the recuperative abilities of infected sinus mucous membranes when aided by conservative drainage created in a precise manner

SUMMARY

Antrum surgery should be reserved for cases in which there is definite evidence of chronic bacterial infection with drainage deficit Such conditions are relatively uncommon It is advocated that surgery be performed through a sublabial incision, but no antrum mucosa be removed with the exception of that necessary to perform biopsies, treat polyps, cysts, abscesses, and to create the nasoantral window A method is described for making a window with size and shape of predictable permanency The results of 17 consecutive cases thus treated are discussed

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INTRANASAL ENCEPHALOMENINGOCELE. REPORT OF A CASE *

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Cleveland, Ohio

The term encephalomeningocele is used because the majority of these tumors contain brain as well as meningeal tissues. Lampert,[1] of Moscow, writing in 1924, refers to two earlier writers, Lissenkoff and Petroff, and says he agrees with them that meningocele as such does not exist. He feels that it is but a secondary manifestation, the primary phenomenon being dystrophy of the brain The brain tissue tends to disappear and become replaced by connective tissue in these lesions. McGillicudy,[2] in 1942, emphasized this fact and urged the use of the name, encephalomeningocele Gisselsson,[3] in 1947 expressed the same thought. Examination of the tissue by the pathologist has usually substantiated this fact.

These lesions are usually considered as congenital herniations of the brain and meninges Guthrie and Dott,[4] however, contend that they are not herniations because the tissue was extruded before the skull was developed and, therefore was not originally intracranial These tumors may occur in or near the midline from the occiput to the nasofrontal region According to Rawling[5] they may digress from the midline only in the nasofrontal region Mood[6] says they are usually noted at the sites of the fontanelles, i e occipital, frontal

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sphenoidal or mastoid, and, less frequently, through the cribriform plate of the ethmoid, the foramen cecum, an enlarged foramen magnum or through one of the various suture lines. Ziegler[7] states that more rarely hernias may occur on the sides of the skull or at the base of the skull. According to Lampert[1] lateral hernias are said not to exist at all. In this he agrees with Rawling.[2]

The various theories of pathogenesis have been thoroughly reviewed by Mood[6] and Gisselsson,[3] so they will be referred to only briefly in this report. The deformity begins during embryonic life and is already developed at birth. In 1827, St. Hillaire[15] attributed the growths to adhesions between the dura, brain and skin of the cranium, causing an arrest of the development of the bony vault. Spring,[16] writing in 1854, expressed the belief that increased fluid pressure within the cranium was the primary causative factor. In 1868, Klementowsky[17] stated that diseased bone during embryogenesis caused a malformation of the skull which permitted these deformities to occur. Steinberg,[18] in 1937, points out that the anterior and posterior ends of the neural groove close about a week after the rest of the tube is closed. If these areas remain connected with the skin, the mesoderm from which the skull is formed cannot grow in between. This leaves a dehiscence and a herniation of the brain and meninges. The majority of these herniations are attached to the intracranial contents by a stalk. More rarely the growth of the cranial bone is resumed, closing off the defect imperfectly, and leaving the herniated tissue isolated outside of the cranium.

Encephalomeningoceles are classified according to their location occipital, sincipital and basal. Von Meyer,[8] in 1890, subdivided the sincipital variety into *1* nasofrontal passing between the frontal and nasal bones and presenting in the midline at the root of the nose, *2* nasoethmoidal passing between the frontal, nasal and ethmoid bones and presenting on the side of the nose, and *3* naso-orbital passing between the frontal, lacrimal and ethmoid bones and presenting in the medial corner of the eye or in the anterior part of the orbital cavity. Heineke[9] and Safianek[10] classified the basal types as follows 1 sphenopharyngeal passing through the sphenoid down into the epipharynx, 2 intranasal passing through the lamina cribrosa into the nasal cavity 3 spheno-orbital passing through the supraorbital fissure into the orbit behind the eyeball 4 sphenomaxillary passing through the supraorbital fissure, then through the infraorbital fissure and into the sphenomaxillary fossa presenting as a tumor on the medial side of the ramus of the mandible or in the zygomatic region

Whatever their location, these tumors are relatively rare. Gisselson[3] says one occurs in 3,500 to 4,000 births Most of these are occipital, 15 to 20 per cent are in the nasofrontal region and 10 per cent are intranasal Ingraham and Swan[11] collected 546 infants and children with spina bifida or cranium bifidum seen at the Harvard Children's Hospital in 20 years The ratio of incidence to the number of new cases was 1 4 150 Of these 546 cases, only 84 were the cranial type, 63 occipital, nine parietal, six frontal five nasal and one nasopharyngeal Molina and Bertola[12] refer to the same 84 cases Neither of these reports states whether these cases have been reported elsewhere in detail

The first case of intranasal encephalomeningocele reported in the literature was that of Richter,[13] in 1813 This was a 60 year-old man with a 'polyp' in the nose and a nasofrontal encephalomeningocele He died following operative removal In 1890, Von Meyer[5] found five cases in the literature and reported one of his own He suggested that more cases might well have been reported, but may have been regarded as nasal polyps or other tumors Fenger[14] reported the first case to be operated successfully in 1895 This was accomplished by opening the nasal cavity, doubly ligating the stalk and packing with iodoform gauze In 1938, Mood[6] said he had found some 40 cases of congenital herniations of the brain and had seen references to some 30 to 35 cases in the older literature. He stated that the anterior hernias are usually divided into basal and sincipital varieties, and in the reported cases the two occur with almost equal frequency ' In 1942, McGillicuddy[2] reported his case and referred to nine that had been previously recorded Gisselsson[3] made an exhaustive search of the literature and reported a case of his own in 1947 He found a total of 34 cases in the literature and gave brief abstracts of 24 of them The present survey has located and abstracted 12 additional cases and reports one case in detail There are other cases in the literature in whom the encephalomeningocele was associated with cleft palate and other large cranial defects These cases are not included

Clark[19] reported two cases of glioma of the nose in 1905 Although these were apparently true glioma, they are mentioned here because of their marked similarity to encephalomeningoceles His first case was a two-year-old boy with a rounded tumor the size of a robin's egg at the nasofrontal region The nose was unusually broad The left nostril was almost completely obstructed by a pinkish-gray polypoid mass Biopsy of the intranasal tumor was followed by free bleeding but no cerebrospinal rhinorrhea The tumor was removed by another surgeon, and the operation was not recorded by Clark His second case was a 10-week-old boy with a pinkish-gray polypoid mass almost completely obstructing the left nasal vestibule The site of attachment seemed to be the nasal septum Three biopsies were taken over a five-month period Each one caused bleeding, but no cerebrospinal fluid leak developed No further operative procedures were done The biopsies on both cases showed gliomatous tissue closely approaching the mucous membrane

Hopkins,[20] in 1906, described a frontonasal encephalocele with an intranasal portion in an 11-month-old infant There was a small swelling over the right nasal bone which had been present since birth Three months previously "polypi" had been removed from the right side of the nose The right nasal fossa was completely occluded by a neoplasm extending into the vestibule At operation this extended into the fossa for one-half inch and was apparently attached to the outer wall near the anterior end of the inferior turbinate He then saw a smooth, grayish, semitranslucent globular tumor at the level of the middle turbinate Pressure on this was transmitted to the frontal tumor and also from the frontal tumor to the intranasal one Cerebrospinal rhinorrhea followed The inant became ill on the fifth day and died of meningitis at the nd of two weeks No operation was done on the frontal umor or its intranasal extension Hopkins comments that he nds no reference to an intranasal examination in any of the reviously reported cases of nasofrontal encephaloceles and uggests that many of them might have had intranasal extensions. He refers to cases by Chabrely[21] and Demme,[22] in oth of which there were similar findings. Chabrely's case ad other gross cranial deformities

Dahmann and Müller[23] in 1925, report a two year old child with a nasal polyp This was removed by a snare. Meningitis and death resulted in four weeks At autopsy a dehiscence was found in the cribriform plate with the stalk of a meningocele passing through it.

Guthrie and Dott,[4] in 1927, describe two cases one was an intracranial glioma with an intranasal extension the second developed left sided nasal obstruction from polyps at the age of 41, nine years after a head injury which had caused paralysis of the right arm and leg Polyps were removed in 1920, 1921 and 1925 The last one was the size of a pigeon s egg, seemingly attached to the middle turbinate It burst on removal, and about one drachm of straw-colored fluid escaped The tissue showed nasal mucosa, hyperplastic meninges, and glial cells in three distinct layers The pedicle of the growth was small, but the exact site of origin could not be determined No cerebrospinal rhinorrhea or meningitis developed Two years later no complications had developed, and the nose was in good condition. This encephalomeningocele would seem to be traumatic, rather than of congenital origin

O Brien,[24] in 1931, reports a meningocele within the middle turbinate. His patient was a 44-year-old man who had a deviated septum, bilateral nasal polyps and purulent discharge. X rays showed definite involvement of both ethmoids and sphenoids In May, 1929, he performed a submucous resection and bilateral polypectomies In June, he started to do an ethmoidectomy, but after removal of the anterior tip of a markedly enlarged and hard left middle turbinate he encountered an immediate flow of bloody fluid Inspection revealed a glistening grayish-white membrane the size of the head of a safety match There was a small perforation in the center from which clear cerebrospinal fluid was escaping He stated that "examination with a probe showed the glistening membrane to be dura extending well back into the middle turbinate" The nose was packed, but the rhinorrhea tended to persist This was followed by meningitis from which he recovered There was no examination of the removed turbinate by a pathologist Careful analysis of this case raises the question whether this was not actually an exposure of dura rather than the uncovering of a meningocele

Kaser's[25] (1944) case was an infant with an encephalocele in the right side of the nose showing in the naris This was seen to move with breathing The infant was wide between the eyes and showed a bulge on the right side of the nose X-rays were negative The growth was biopsied and this was followed by cerebrospinal rhinorrhea The pathologist reported the tissue as encephalocele

In 1947, Anderson[26] covered the entire subject thoroughly and presented some very exceptional illustrations of his case This was an 11-year-old boy who had had a "nasal polyp" removed at the age of four This was followed by a watery rhinorrhea and meningitis from which he recovered The rhinorrhea had persisted During the five months before his referral for operation he had three attacks of meningitis Examination revealed a spherical, glistening, white mass in the right nasal sulcus almost obliterating the right middle turbinate and apparently originating in the superior meatus X-rays were normal A right frontal craniotomy was done, revealing a stalk attached to the right frontal lobe and leading down through a defect 2 mm in diameter in the cribriform plate The stalk was cauterized and divided The aperture was lightly cauterized and closed with a muscle strip and four dural flaps, the whole being sealed over with a strip of gelfoam The intranasal portion of the tumor was not disturbed and gradually atrophied over the ensuing months On the fifth postoperative day he had a series of generalized convulsions from which he recovered There was no postoperative cerebrospinal rhinorrhea According to the classifications of Heineke and Safranek this is a true intranasal encephalomeningocele and not one of the sphenopharyngeal variety

Adson and Uihlein [7] (1949) mention 18 cases of spontaneous cerebrospinal rhinorrhea in their article on intracranial repair of defects in the ethmoid and frontal sinuses They attribute all of these to nasal meningoceles X-rays revealed defects in the cribriform plate in three of the 18 cases They found single fistulous openings in 10 cases and two or more such openings in eight cases Nasal polyps were observed by their associates in 11 cases Nine of their cases had had previous operation on nasal polyps Only two cases are identified being outlined by Dr Hallberg Only these two cases are counted in the present survey One was a seven-year-old girl with a meningocele in the right side of the nose and the other a man in his forties with one in the left side of the nose Both of these meningoceles had a whitish look and made their appearance between the septum and middle turbinate Intracranial repair of the defect in the bone is advocated Fourteen of the 18 cases were cured Three cases were failures and two were reoperated without success

Williamson and Barelli [28] (1951) reported two cases operated by a frontal craniotomy In the first case the stalk was transected intracranially and the defect in the bone closed by a muscle transplant and gelfoam The intranasal tumor was not disturbed and gradually reduced in size The second case was of traumatic origin The intranasal tumor mass delivered into the cranial cavity at operation and the defect in the cribriform plate was closed by a graft of split frozen rib and dural flaps X-rays in both cases failed to reveal the dehiscence in the bone The first case was a five-year-old boy from whom a nasal 'polyp' had been removed at the age of nine months This was followed by a persistent and continuous watery rhinorrhea The 'polyp' had again been removed five weeks before the patient was referred Following this the cerebrospinal rhinorrhea had become more profuse

"Amazingly enough, the child had never had meningitis" The bridge of the nose was very broad and there was a slight internal strabismus There was a large, gray, glistening mass in the right nasal cavity Their second case was a four-year-old girl who had sustaind a linear skull fracture into the right ethmoid region four years previously Temporary rhinorrhea of a few days' duration occurred Six weeks previously she had had a pneumococcic meningitis which responded to antibiotics There was a grayish mass high in the right nasal cavity and fluid could be seen to drain from it

Beyer, Blair and Lipscomb[29] (1951) report a meningocele in a 23-month-old boy He had developed constant nasal discharge and obstruction of the left nostril at the age of nine months He had had a nasal operation seven and three months previously and a tonsillectomy and adenoidectomy four months before The left nostril was occluded by a pale, soft tumor which was continuous with the septal mucosa and was free of any lateral attachment On packing the nose gently with an adrenalin pack under general anesthesia the tumor disappeared after five minutes It could then be seen refilling in the olfactory groove X-rays showed a dehiscence in the cribriform plate on lateral projection A left transfrontal craniotomy was performed and a dehiscence 1 cm x 3 mm was found in the cribriform plate This was closed by a free pericranial graft The result was excellent

Walker, Moore and Simpson[30] (1952) report the case of a baby girl who was observed to have a growth in the right nostril at birth A portion of this was removed with a snare at the age of 12 hours Microscopic sections showed it to be an encephalocele Clear fluid drained from the nose after this biopsy There was a reddish, soft mass protruding from the right nostril The mass filled the right nasal cavity and could be seen in the pharynx extending down from the nasopharynx A tracheotomy was done at the age of one month and a week later a right frontal craniotomy was done The pedicle was coagulated and divided intracranially and the bony defect closed with a dural flap held in place by gelfoam Three months later the mass in the nose and nasopharynx was removed surgically There was no further cerebrospinal fluid leak and no meningitis developed

The diagnosis of the intranasal variety of encephalomeningocele is not easily made There are certain definite findings, however which should differentiate this lesion from the ordinary nasal polyp and which should put one on guard against doing a casual intranasal operation If the condition is not properly diagnosed and the growth is removed by a snare there is a prompt leak of cerebrospinal fluid, and this is usually rapidly followed by meningitis Since this is a congenital deformity, it should be encountered in infancy and early childhood In Gisselsson's[3] 24 abstracted cases about half were over the age of 10 His own case was 15, however, the symptoms usually dated back to childhood In the additional cases abstracted in this series, three were over the age of 10 and eight were under this age These patients have a very widened nasal root with an abnormally wide distance between the eyes (see Fig 1) This has been noted and commented upon repeatedly since attention was called to it by Fenger[11] in 1895 The profile (see Fig 2) may be entirely normal The growth hangs down from the roof of the nasal cavity like a polyp, but the stalk goes up between the middle turbinate and septum. The stalk of a polyp usually goes up lateral to the middle turbinate If the growth is large and occludes the nasal cavity, as in the case reported later, it is attached to the septum (see Fig 3) and a probe will pass up to the roof of the nose only laterally and posteriorly The probe will pass only part way up along the septum and anteriorly This point was stressed by Hallerman[21] in 1932, when he made a plea for a positive diagnosis without biopsy or diagnostic puncture. He felt that either of these procedures resulted in a fatal meningitis In the formation of this deformity the herniation occurs through the cribriform plate As the herniation increases in size and descends into the nasal cavity it pushes the nasal mucosa ahead of it This tends to strip the mucosa from the septum and the under side of the nasal bone The stalk actually goes up to the cribriform

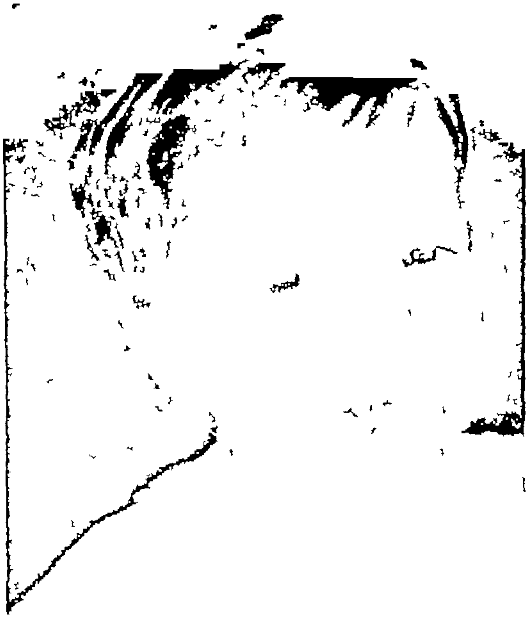

Fig 1 Note width between eyes

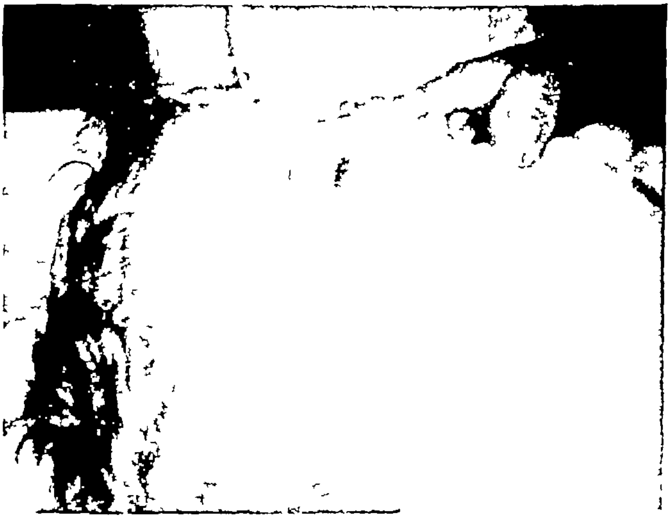

Fig 2 Normal profile

plate, but the reflection of the mucosa makes it appear to be attached to the septum Brain pulsations or change in size with straining or crying has not been seen in any of the intranasal tumors Both of these findings may occur in the larger occipital and sincipital herniations Crying during the ex-

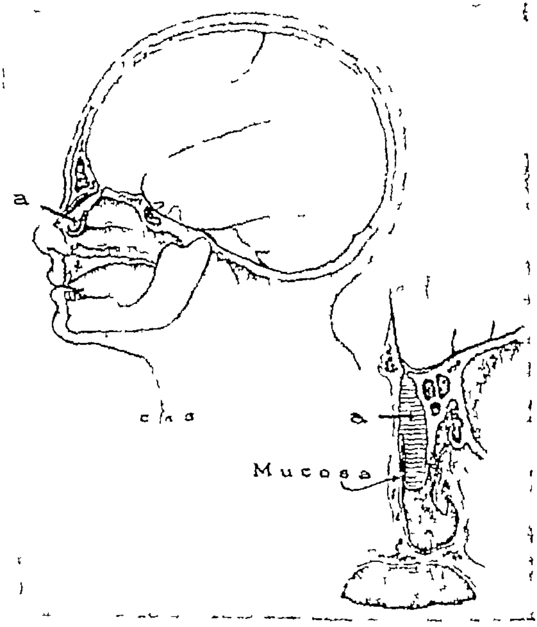

Fig 3 Encephalomeningocele (a) in nasal cavity Note reflection of mucosa from septum onto herniated mass.

amination may make the tumor rather firm on palpation and it may not appear cystic except under general anesthesia. Adson and Uihlein[27] list their 18 cases under 'spontaneous cerebrospinal rhinorrhea (nasal meningoceles)," stating that nine of them had had previous surgical removal of nasal polyps

According to Gisselsson[3] cerebrospinal rhinorrhea does not occur unless there has been some trauma, surgical or otherwise In his series of 25 cases, cerebrospinal rhinorrhea did not occur spontaneously It was reported only as following biopsy or surgical removal The same is true of the present series of specifically reported cases

X-rays rarely show a cranial defect Six of Gisselsson's[3] 25 cases were X-rayed, and none showed a dehiscence Four of the present series were said to show defects in the cribriform plate in Roentgenograms Natanson[12] suggested that a low placed lamina cribrosa might be associated with a meningocele

Prior to the advent of the sulfas and antibiotics, diagnostic puncture was fraught with grave danger of meningitis and death Even now it should not be undertaken lightly and then only if one recognizes the possibilities and is prepared to meet all eventualities Strict asepsis should be observed, and the patient should be well saturated with one of the antibiotics Aspiration yields a crystal clear fluid, sometimes slightly yellow, with a chemical analysis similar to cerebrospinal fluid The amount of protein in the cerebrospinal fluid is 15 to 45 mg per 100 cc In transudates it is usually less than 2 5 mg per 100 cc The amount of glucose in both of these is the same as that found in the blood plasma [3, 14]

CASE REPORT

A white male infant 20 months of age was referred on April 29, 1950, because of a growth in the right nasal cavity Four months previously the parents had noticed a bump on the right side of the nose and that there was a right sided nasal obstruction There were no ear complaints The child did not have many colds and he was in excellent general health The ears and throat were normal The child was very broad across the bridge of the nose and there was an abnormal width between the eyes (see Fig 1) The right nostril was occluded by a rounded red dish mass (see Fig 4) The child cried vigorously during the examination and the mass felt firm to palpation and was noncompressible It did not increase in size with the crying Roentgenograms showed a rounded soft tissue mass in the right nasal cavity with a bending and displacement of the right lateral wall and of the septum No dehiscence in the cranial vault was visualized The diagnosis of encephalomeningocele was considered but because of the apparent firmness of the tumor it was felt that this was a solid tumor like a fibroma or possibly a teratoma

He was hospitalized on May 21 1950 The following day he was taken to surgery Examination under general anesthesia revealed the tumor to be definitely cystic Probing showed it to be attached by a broad base to the upper portion of the septum and the anterior wall of the nasal cavity The probe passed up to the vault behind the tumor The nose and exposed portion of the tumor was thoroughly cleansed and sterilized Under strict asepsis a needle was inserted into the cystic mass and about 1 cc. of a crystal-clear fluid was aspirated into a syringe. There was very little bleeding and no subsequent leakage The removal of the fluid did not appreciably reduce the size of the mass. The patient was returned to his room and he was placed on 300 000 units procaine penicillin a day Analysis of the fluid showed a total protein of 41 mg. per 100 cc Urinalysis was normal. Bleeding time was one minute 15 seconds and clotting time was two and one-half minutes.

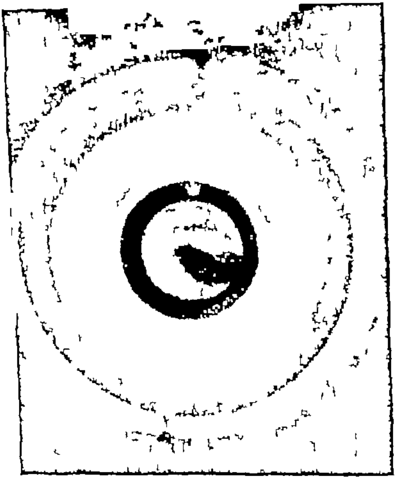

Fig 4 Tip of encephalomenincocele showing in right nostril.

It was felt that the diagnosis of intranasal encephalomeningocele was established Neurosurgical consultation was obtained and it was decided to try to prove a definite connection between the nasal cyst and the *intracranial contents*

On May 26 1950 the child was returned to surgery and given a general anesthetic. Dr William A. Nosik performed a lumbar puncture. The initial pressure ranged from 230 to 240 mm. of water because of forced respirations When this had become stabilized pressure was exerted on the intranasal cyst There was no change in the spinal fluid pressure Five cc of clear, colorless spinal fluid were removed and 2 cc of indigo carmine were injected into the spinal canal. After waiting 10 minutes, 1 3 cc of clear, colorless fluid were aspirated from the cyst. There was no evidence of the dye An equivalent amount of pantopaque was injected into the cyst After about 15 minutes a series of X rays was taken with the head held right side up, upside down and tilted to either side The pictures showed a large cyst in the nasal cavity filled with pantopaque (see Fig 5) but no evidence of the radiopaque material inside the cranial cavity Analysis of the spinal fluid showed 16 mg per 100 cc of total protein, 75 mg of sugar and one W B C Analysis of the cystic fluid showed 39 mg of total protein, 75 mg of sugar, 19 W B C and many

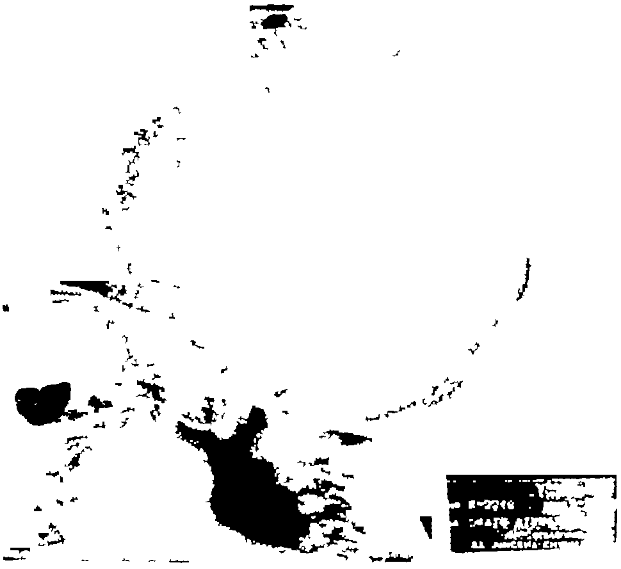

Fig 5 Pantopaque in encephalomeningocele

R B C X rays were repeated on May 23, 26 and 27 None of these revealed any intracranial pantopaque Three hundred thousand units of procaine penicillin were given intramuscularly daily from May 22 to June 5 The temperature ranged from 36 5° to 37 5° C except for spikes of 38 4° on May 23, 38 5° on May 29, and 38 6° on June 2 There was a slight cerebrospinal rhinorrhea He was discharged home on June 5 for a rest before having his operation

His stay at home was uneventful He was readmitted to the hospital on June 28, 1950 Blood studies showed 3 720 000 R B C, Hgb 9 5, and W B C 13 100 On June 29 he was placed under intratracheal general anesthesia The cyst was removed intranasally by the author The nasal mucosa was incised, exposing the cyst wall, and was then dissected from the cyst in an attempt to remove the cyst in one piece, however, when the dissection reached the upper part of the nasal cavity the cyst ruptured and the loose mucosa and cyst had to be removed with a nasal snare The upper portion of the cyst contained white rather soft tissue. After removal a dehiscence could be seen in the right cribriform plate The right middle turbinate was atrophic The nose was packed with gauze

Dr William A. Nosik[34] performed a right frontal craniotomy The dura was dissected from the floor and right olfactory groove. This revealed a dehiscence in the cribriform plate 1 cm x 4 mm. in size through which the intranasal packing could be seen. A small square of tantalum gauze folded double to the size of half a postage stamp was placed over the opening A pad of gelfoam was sealed over this and a larger single piece of tantalum screen was placed over the whole area. The dura was allowed to fall back into position and the wound was closed.

The child tolerated the procedure well. The temperature rose to 39 6° C on June 29 but was down to 38 9° the following morning and below 38° by evening He received 400 000 units of procaine penicillin intramuscularly each day until July 6 There was no postoperative cerebrospinal rhinorrhea and he was discharged from the hospital on July 8 1950 He has been seen several times since then and has been in excellent health. There was some crusting in the right nasal cavity for about a month but after that the nose has been in good condition.

MICROSCOPIC EXAMINATION

"The sections on this slide represent a mixture of tissues Some of the pieces are partially covered by a mucous membrane composed of nonkeratinized stratified squamous epithelium which is continuous with ciliated pseudostratified columnar epithelium Mucous glands are present in the tissue underlying the latter epithelium. The deep surface of some of these pieces is occupied by a dense collagenous tissue similar to that which will be described later The latter are composed of a mixture of unmistakable glial tissue and collagenous tissue The glial tissue shows evidence of compression and shows a focal xanthomatous reaction The collagenous tissue is arranged in thick, broad, wavy bands In some locations a loose, highly vascularized, fibrillar tissue is present between the glial and collagenous tissues. In the fibrillar and glial tissues there are widely dispersed calcospherites and there is a foreign body reaction characterized by the presence of multinuclear giant cells. Occasional rounded or prismatic refractile foreign bodies of unidentified nature are situated adjacent to, or within, the giant cells. Considered together, the mixture of tissues is consistent with a meningoencephalocele of the nasal cavity"

DISCUSSION

A careful analysis of the treatment and results in Gisselsson's[3] series and those given in this report reveals some very interesting and pertinent facts In the former series, 15 died as a result of meningitis following biopsy or intranasal operation Of the 10 who survived, two were not operated and only two had an intracranial repair of the bony defect In the present series only two died of meningitis following intranasal procedures The outcome of one case that was biopsied is not recorded Ten cases survived, two following intranasal operation (one of these may not have been an encephalomeningocele) and eight following intracranial closure of the bony defect

Rawling,[5] writing in 1904, said that a perusal of the reported cases reveals a high mortality If they survive, the late results are even more unsatisfactory If not treated surgically they die at an early age This same thought is expressed by Lampert[1] as late as 1924 He adds that the prognosis is exceedingly bad, whether the patient is treated or not Both of these authors are referring to the whole group of encephalomeningoceles — occipital, sincipital and basal In 1906, Hopkins[20] said, "The rate of mortality from operation upon cerebral hernia is high; though less so than before the days of asepsis, and a recurrence often follows, even when the primary operation is successful If the protrusion is into the nasal cavities the idea of operation is not to be entertained"

These conclusions were made before the days of the antibiotics and were the result of the types of operations which were done on these cases at that time The high mortality was due to *1* not recognizing the true diagnosis of the condition, and *2* the intranasal biopsy or removal without an attempt to close the bony defect intracranially The desirability of this latter procedure can hardly be denied About half of the cases subjected to intranasal procedures alone have died Of those who did survive, many have had persistent cerebrospinal rhinorrhea with the specter of meningitis hovering over them The reported cases in which the bony defect was repaired intracranially have all survived and have had no cerebrospinal leak In some of the more recent reports the stalk of the tumor has been ligated or cauterized and severed intracranially and the defect closed off No intranasal operation was done. They report that the intranasal mass gradually atrophied and reduced in size It would seem likely that this would occur in those masses that were largely cystic. In the case reported by Walker, Moore and Simpson[10] the tumor was very large and more solid This did not regress in size and was successfully removed intranasally three months later Because of the possible danger of a delayed removal of the intranasal mass resulting in injury to the tissue sealing off the bony defect, it is suggested that the two procedures be combined and performed at the same time

SUMMARY AND CONCLUSION

1. The literature on intranasal encephalomeningoceles has been reviewed, and one case reported
2. The diagnosis should be established before any operative procedure or biopsy is done This can be accomplished by observing the following points *a.* Abnormal width between the eyes *b* Cystic polypoid mass in nose with attachment between the middle turbinate and septum or to the septum and anterior walls of the nasal cavity *c* Present from birth
3. Roentgen evidence of bony cranial defect is seldom seen
4. Brain pulsations and increase in size on crying are not seen.
5. Intracranial repair of the bony dehiscence combined with intranasal removal of the herniated mass is advocated

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PARACUSIS WILLISII *

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INTRODUCTION

Paracusis Willisii is an associated symptom observed clinically in people suffering from bilateral conductive deafness The paracusic or subject observing the effect of Paracusis Willisii has the sensation that it is possible to hear more easily in the midst of a noisy surrounding than in a relatively quiet ambient For example, the paracusic reports that the voices of people situated three or four feet away on a moving train can be heard, while it is only with difficulty that the voice of an adjacent person is heard when the train is stopped Of the many reported incidents, the following is an exceptionally good example to establish the apparent phenomena of paracusis One paracusic has observed that in a moving automobile a person with normal hearing required a greater intensity setting of the automobile radio than did the paracusic, and the converse when the car was stopped

The scientific proof of the existence of paracusis by measurement or otherwise reported to date has been practically fruitless With the aid of modern electroacoustical devices, we have been able to prove such a condition does exist, is of clinical significance and is a measureable quantity

HISTORY OF PARACUSIS

The following brief history starts in 1680 when the initial observation of the phenoma was recorded by Willis Not until

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1875 Buck and later Politzer (1880) proposed the theory that loud extraneous noise shook the ossicular chain, thereby lessening its rigidity, allowing the paracusic to hear better

In 1877 von Troltsch voiced the opinion that the increase in hearing was only apparent. Paracusis, he said, was found only in conductive deafness, in which the hearing loss is limited chiefly to the lower frequency range. Since most noise is confined to this region, the paracusic, therefore, is not bothered by the surrounding noise and is able to hear with care the raised voice of the speaker This same theory was later revoiced by Kranz and Pholman in 1924

Meanwhile, Urbantschitsch, in 1913, stated that the ambient noise on reaching the cochlea actually increased the sensitivity of the organ of Corti and thereby the acuity of hearing

Various experiments have been carried out in the past in an endeavor to prove or disprove the existence of paracusis Some of the more significant are recalled as follows

Experiment No 1 — Hastings and Scarff[1] (1928)

Method An electric audiometer and an electrically driven tuning fork were arranged in such a manner that the sounds of the tuning fork could be transmitted to either ear The frequency of the audiometer was 728 double vibrations or cycles per second while the fork had a frequency of 72 cycles per second. The latter was used as a source of extraneous or masking noise relative to that of the former or investigating tone

Results *a* In two cases of nerve deafness there was found a greater loss of hearing that is, an increased threshold, for the investigating tone when the masking tone was applied to the same ear but no change of threshold when the masking tone was applied to the opposite ear

b In 60 cases of middle ear deafness it was shown that the threshold was increased whether the masking tone was applied to the same ear as the investigating tone or to the opposite ear

c In two cases of otosclerosis the threshold was found to decrease in the presence of the masking tone, that is, a greater acuity of hearing for the investigating tone and thereby a case of true paracusis.

Experiment No 2 — Shambaugh[2] (1927)

Method A Western Electric type 2A audiometer was fitted with special ear pieces. The rim of one ear piece was solid and covered with soft rubber to exclude extraneous noise while the rim of the corresponding ear piece was perforated to admit the outside noise An audiometric investigation of both normals and otosclerotics was carried out on a train both while stopped and while moving.

Results *a* The acuity of the hearing of the normal ear was decreased in the presence of the extraneous noise

b The acuity of the hearing of the otosclerotic ear was decreased in the presence of the extraneous noise

Conclusion The existence of paracusis as a true phenomena was disqualified, as it was by von Troltsch and that the occurrence was contributed only to the fact that a normal person naturally raised the intensity of his voice when speaking in a noisy ambient

Experiment No 3 — Guttmann and Hamm[3] (1930)

Method Two electric oscillators with their accompanying amplifiers and attenuators were used to excite a telephone receiver One oscillator produced a masking or interfering tone of 300 cycles per second, while the other was a variable primary tone of 300, 510, 810 and 2,500 cycles per second The procedure of the test consisted of determining for both normal and deafened ears the threshold for the primary tone both in the presence and the absence of the masking tone The intensity of masking used was 50 decibels above the threshold level for the same

Results *a.* For both the perceptive and the conductive deafened ear, it was reported that in the presence of the masking tone a slight increase in the intensity of the primary tone produced a greater subjective sensation of hearing than in the normal ear, with the greatest change in the otosclerotic ear

b In a few cases of extreme deafness, where only a 20 decibel masking tone was used relative to threshold for the same, there was the occasional ear in which the primary tone was more easily heard with the interfering noise than without the noise

Experiment No 4 — McFarlane[4] (1931)

Method An electric phonograph was used as a source of speech, while a conventional audiometer was used as a source of controlled pure tone. The pure tone was (512 or 1,024 cycles per second) held constant, the speech was applied to the opposite ear and varied in intensity to determine the speech threshold The reverse of this test was used, in which case the speech served as the masking source.

Results *a* The acuity of the normal ear was decreased in the presence of extraneous noise

b The acuity of the abnormal ear did increase slightly when small noises were presented

Conclusion True paracusis did exist.

EXPERIMENTAL PROCEDURE

The procedure followed by our investigators, at the Otological and Audiometric Laboratory of the University of Toronto, was to seat the candidate facing the sound source, with head fixed at a distance of 60 inches, as measured from the ear proper to the diaphragm of the sound source (see Fig 1) The relative position of the subject's head, the sound source, and the walls of the room was retained for all of the cases investigated Each candidate was subjected to a precision audiometric examination, including unilateral investigation

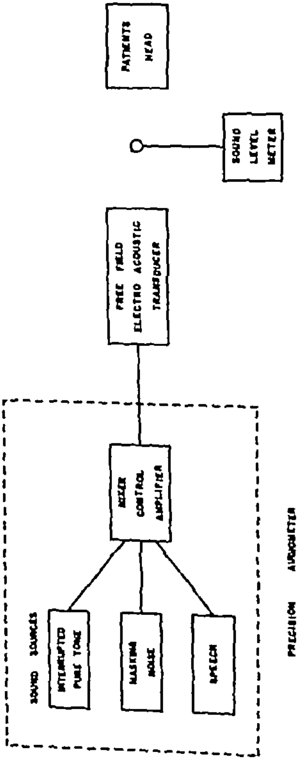

Figure 1

by air and bone conduction and bilateral open field investigation of the threshold response for the pure tones 125, 250, 500, 1,000, 2,000, 4,000 and 8,000 cycles per second, interrupted at a rate of two cycles per second, presenting equal periods of stimulation and silence The interrupted tones were used for two reasons

1. To prevent the formation of standing waves in the soundproof room
2. To produce a second degree of stimulation in the ear

The bilateral pure tone open field portion of the examination was repeated when an ambient "white noise," the sound level of which in the region of the candidate's head, as measured with a General Radio Type 759-B Sound Level Meter, "c" scale weighted, was 90 decibels relative to 10^{-16} watts per square centimeter, at a frequency of 1,000 cycles per second

To establish a reference standard for all such tests, 12 candidates, as determined audiometrically, with normal or better than normal bilateral hearing were subjected to this latter procedure In all, 50 abnormal subjects are reported on, including persons with both bilateral and unilateral hearing defects, classified as early and advanced conductive deafness mixed deafness and perceptive deafness

Paracusis was initially believed to be confined to the conductive deafened ear, therefore, sound stimuli between 125 and 2,000 cycles per second were alone used for the pilot investigation of the initial eight persons tested

RESULTS AND OBSERVATIONS

The complete observations made for all candidates reported on are on file in the Otological and Audiometric Laboratory Due to the magnitude of the volume of all such results of the subjects' audiometric examinations, it is only possible in this paper to present the results classified as to the type of deafness determined clinically and audiometrically of the candidates' hearing ability, expressed in decibels relative to the average normal for bilateral open field investigation, with interrupted pure tones in and out of a known noise field

The results of the initial examination of eight cases of advanced bilateral conductive deafness are as recorded in

Table 1 From these results, Case 1 is presented graphically as shown in Fig 2, including the interrupted pure tone audiograms by air conduction and bone conduction and the bilateral open field threshold response, expressed relative to the average normal threshold for the test tones, in both an ambient

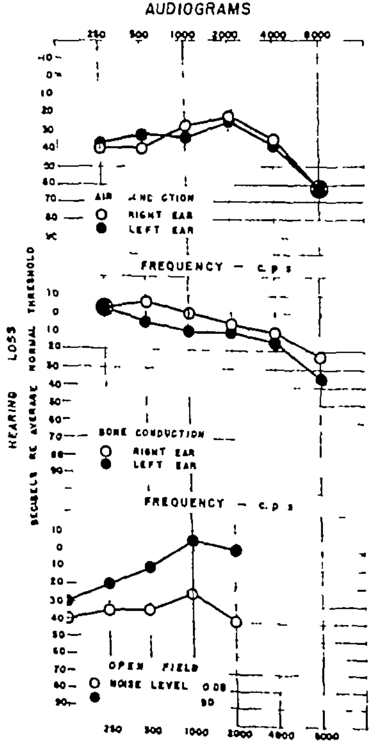

Figure 2 – Case 1

noise field of zero and 90 decibels The improvement of hearing in the noise field is indicated by the differential in decibels We see from the lower graph that the least benefit is attained at 125 cycles per second and a maximum benefit is had at the 2,000 cycle frequency

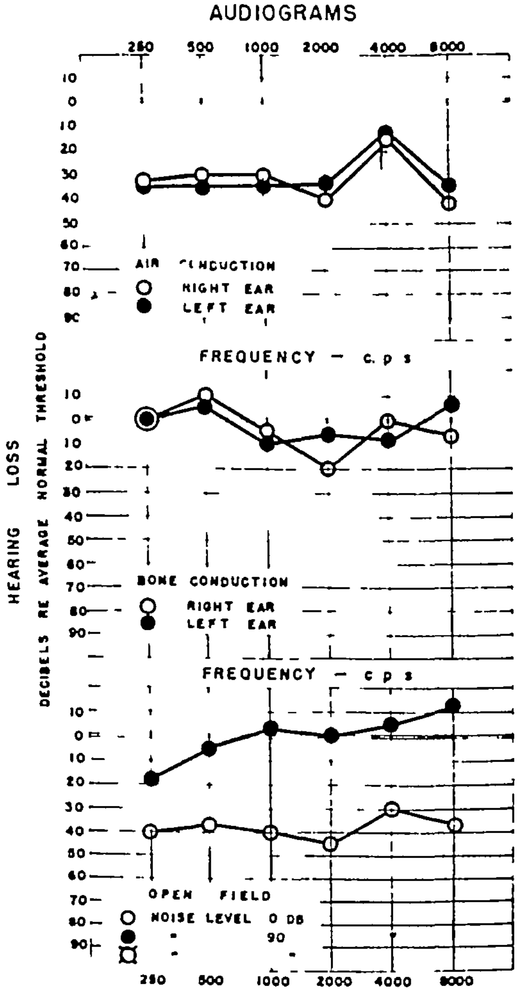

Figure 3 — Case 9

The results of nine cases of advanced bilateral conductive deafness are recorded in Table 2 The graphical presentation of the complete audiometric examination of Case 9 is shown (see Fig 3) The improvement in hearing as evidenced between an ambient noise level of zero and one of 90 decibel loudness, is as seen in our initial investigation, to indicate

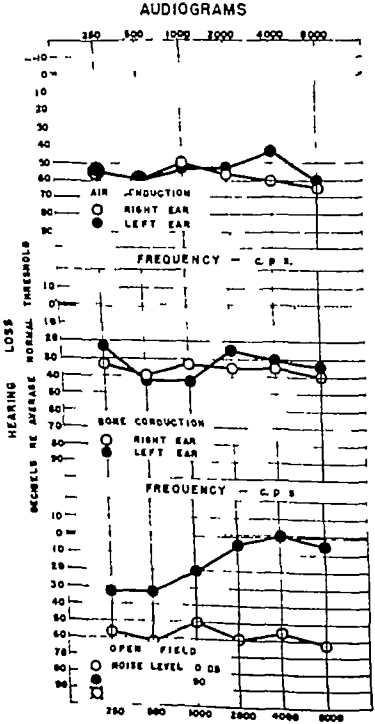

Figure 4 — Case 25

a minimum improvement of hearing for the lower pitch frequencies with a steady increase in improvement to the mid frequencies between 1,000 and 2,000 cycles per second, at which point a normal degree of acuity is had, advancing to a better than normal degree of hearing for the higher order frequencies

Three cases of early bilateral conductive deafness are as recorded in Table 3, from which the same tendency to improvement of hearing acuity in a noisy ambient is evident

Four cases of bilateral conductive deafness, with an increased loss of hearing at the 2,000 cycle frequency, are as presented in Table 4 Again the improvement in hearing acuity in a noise ambient is evident

Four cases of bilateral mixed deafness, made up of an advanced state of conductive deafness and an accompanying degree of cochlear degeneration were recorded in Table 5 The graphical presentation of Case 25 is as shown in Fig 4, from which we see the same differential of hearing improvement between that for an ambient noise level of zero to that of 90 decibels of loudness, with the only limitation that this improvement of hearing is determined by the basic cochlear sensitivity

The report of the investigation of seven cases of bilateral mixed deafness in which there was an accompanying increased loss of hearing for the frequencies above 2,000 cycles per second, are included as recorded in Table 6 The graphical presentation of Case 29 (see Fig 5), as would be expected shows an improvement in hearing for the pure tones up to and including 2,000 cycles per second, with a marked deficiency for hearing acuity, both in the zero and 90 decibel loud ambient noise fields

Only two cases of early bilateral nerve deafness were available for investigation These are as presented in Table 7, in which we see there is no significant change in hearing acuity in or out of these noise fields

Of the two cases of bilateral nerve deafness recorded in Table 8, the graphical presentation of Case 38 (see Fig 6) indicates that there is no significant change, or increase in hearing between the lowest frequency and the highest frequency investigated, when the test procedure is carried out

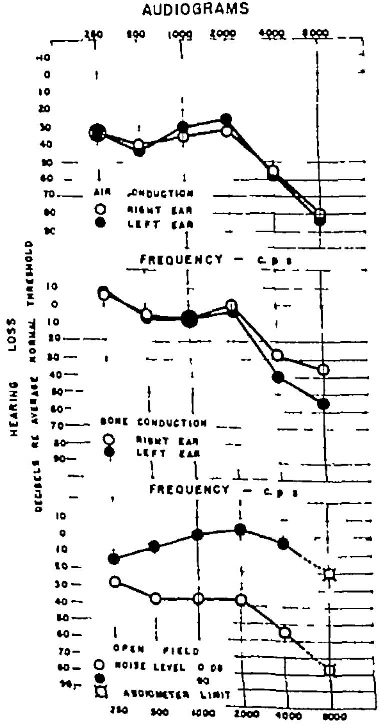

Figure 5 — Case 29

in the 90 versus the zero decibel loud ambient noise field The interpretation of this graph will be more readily understood from the explanation presented of this phenomena

The remaining Cases 40 to 50, inclusive, are examples of bilateral hearing defects of which one ear falls within normal sociably acceptable limits, of which there are

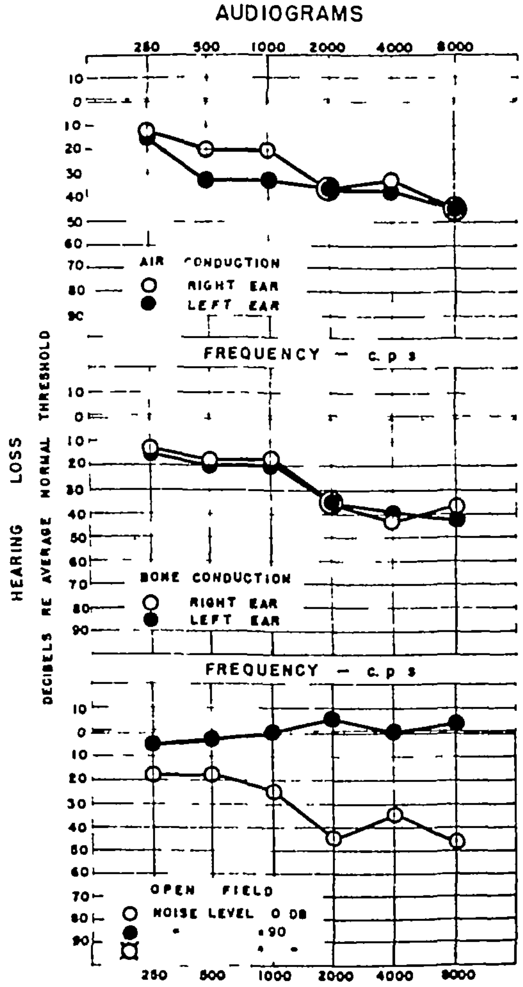

Figure 6 – Case 38

Four cases of unilateral deafness as shown in Table 9

Five cases of unilateral conductive deafness as presented in Table 10

Two cases of unilateral mixed deafness as recorded in Table 11

TABLE-I

INITIAL EIGHT CASES OF ADVANCED BILATERAL CONDUCTIVE DEAFNESS

CASE NUMBER	BILATERAL PURE TONE THRESHOLD - TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD TEST FREQUENCIES - CYCLES PER SECOND									
	125		250		500		1000		2000	
	MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS	
	0	90	0	90	0	90	0	90	0	90
1	40	30	35	20	35	10	25	-6	40	0
2	45	30	43	20	40	7	33	2	33	0
3	35	28	40	23	43	15	30	0	35	0
4	37	25	25	18	28	7	20	2	23	0
5	37	28	35	20	30	10	20	7	50	3
6	b75	a50	35	33	40	17	25	3	35	10
7	27	38	30	23	30	8	33	2	28	-4
8	40	20	35	33	40	17	25	3	35	10

TABLE – 2

NINE CASES OF ADVANCED BILATERAL CONDUCTIVE DEAFNESS

CASE NUMBER	BILATERAL PURE TONE THRESHOLD – TONE INTERRUPTED *DECIBELS RE AVERAGE NORMAL THRESHOLD* TEST FREQUENCIES — CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS	
	0	90	0	90	0	90	0	90	0	90	0	90
9	40	18	38	5	40	-2	45	0	30	-5	37	-12
10	38	15	40	-3	25	-10	38	-7	20	0	27	-17
11	52	18	50	7	30	0	35	-2	38	3	30	10
12	38	18	43	12	38	0	38	-5	25	5	27	-2
13	40	13	23	2	38	-10	33	-7	30	-5	40	0
14	50	25	43	5	35	0	43	0	33	-7	52	0
15	45	28	43	12	48	8	45	5	50	5	62	0
16	43	16	60	10	35	3	35	0	40	-5	27	-10
17	28	20	33	7	28	0	40	-2	20	0	35	0

TABLE — 3

THREE CASES OF EARLY BILATERAL CONDUCTIVE DEAFNESS

CASE NUMBER	BILATERAL PURE TONE THRESHOLD — TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD											
	TEST FREQUENCIES — CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS DECIBEL		MASKING LOUDNESS-DECIBELS		MASKING LOUDNESS DECIBEL		MASKING LOUDNESS-DECIBELS		MASKING LOUDNESS -DECIBELS		MASKING LOUDNESS-DECIBELS	
	0	80	0	80	0	80	0	80	0	80	0	80
18	30	13	33	5	23	-2	40	5	25	-2	15	2
19	30	10	33	8	33	3	38	3	18	8	12	-10
20	48	5	38	5	33	0	40	0	38	0	20	-10

TABLE – 4

FOUR CASES OF BILATERAL CONDUCTIVE DEAFNESS WITH INCREASED LOSS AT 2000 c.p.s

CASE NUMBER	BILATERAL PURE TONE THRESHOLD — TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD											
	TEST FREQUENCIES — CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS	
	0	90	0	90	0	90	0	90	0	90	0	90
21	47	22	57	12	43	0	70	10	53	8	67	3
22	40	15	48	2	33	-7	45	3	28	3	13	-10
23	26	10	25	0	25	5	48	-10	33	7	15	-15
24	46	18	50	10	53	5	63	3	43	3	22	-7

TABLE – 5

FOUR CASES OF BILATERAL MIXED DEAFNESS TYPE NO I

CASE NUMBER	BILATERAL PURE TONE THRESHOLD – TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD TEST FREQUENCIES – CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS DECIBEL		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBEL	
	0	90	0	90	0	90	0	90	0	90	0	90
25	56	33	62	30	60	20	60	8	58	0	62	8
26	h75	h50	h80	h42	73	2	78	17	60	20	h77	h20
27	46	13	38	0	35	8	40	0	40	0	47	0
28	40	20	43	10	40	3	50	3	38	3	45	-8

TABLE–6

SEVEN CASES OF BILATERAL MIXED DEAFNESS TYPE NO 2

CASE NUMBER	BILATERAL PURE TONE THRESHOLD – TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD											
	TEST FREQUENCIES — CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS-DECIBELS		MASKING LOUDNESS DECIBELS	
	0	90	0	90	0	90	0	90	0	90	0	90
29	28	15	37	7	38	0	38	-2	65	3	75	20
30	50	30	60	12	53	10	83	20	93	20	77	20
31	43	18	45	7	48	5	78	0	83	5	77	20
32	38	13	43	5	25	3	48	0	63	3	62	20
33	43	16	38	10	30	8	33	10	48	5	52	20
34	48	25	50	10	38	-5	45	0	50	3	67	-5
35	43	20	45	7	33	-5	48	0	60	-5	69	0

TABLE – 7

TWO CASES OF EARLY BILATERAL NERVE DEAFNESS

CASE NUMBER	BILATERAL PURE TONE THRESHOLD – TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD											
	TEST FREQUENCIES – CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBEL		MASKING LOUDNESS-DECIBEL		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS	
	0	90	0	90	0	90	0	90	0	90	0	90
36	-2	2	5	-5	-10	3	3	3	30	0	47	20
37	-2	0	-10	0	7	0	10	2	15	5	32	10

TABLE 8

TWO CASES OF BILATERAL NERVE DEAFNESS

CASE NUMBER	BILATERAL PURE TONE THRESHOLD—TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD											
	TEST FREQUENCIES — CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS—DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS	
	0	90	0	90	0	90	0	90	0	90	0	90
38	15	5	15	2	25	0	45	5	35	0	47	-2
39	35	30	43	20	38	10	30	7	15	7	35	5

TABLE — 9

FOUR CASES OF UNILATERAL DEAFNESS — ONE EAR PRACTICALLY NORMAL

CASE NUMBER	BILATERAL PURE TONE THRESHOLD—TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD											
	TEST FREQUENCIES — CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS-DECIBEL		MASKING LOU DECI L		MASKING LOUDN 80-DECIBELS		MASKING LOUDNE 8-DECIBELS	
	0	80	0	80	0	80	0	80	0	80	0	80
40	15	6	23	3	23	6	25	1	20	6	20	4
41	25	5	28	0	18	3	35	0	35	0	5	-5
42	40	10	30	6	23	5	30	8	17	3	33	20
43	23	2	20	2	18	3	43	3	45	3	77	10

TABLE - 10

FIVE CASES OF UNILATERAL CONDUCTIVE DEAFNESS

CASE NUMBER	BILATERAL PURE TONE THRESHOLD - TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD TEST FREQUENCIES — CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS	
	0	90	0	90	0	90	0	90	0	90	0	90
44	40	23	38	10	28	3	18	0	28	0	35	-10
45	35	15	38	5	25	-2	25	-2	20	-7	32	15
46	43	25	45	10	35	5	53	0	38	8	42	7
47	38	25	30	17	25	5	23	-2	13	-2	22	20
48	40	20	37	5	35	0	45	0	43	0	40	-10

TABLE - II

TWO CASES OF UNILATERAL MIXED DEAFNESS TYPE NO I

CASE NUMBER	BILATERAL PURE TONE THRESHOLD — TONE INTERRUPTED DECIBELS RE AVERAGE NORMAL THRESHOLD											
	TEST FREQUENCIES — CYCLES PER SECOND											
	250		500		1000		2000		4000		8000	
	MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS		MASKING LOUDNESS DECIBELS	
	0	90	0	90	0	90	0	90	0	90	0	90
49	33	15	28	0	25	0	38	3	48	5	60	3
50	47	20	43	7	43	3	53	3	60	0	65	20

EXPLANATION OF PARACUSIS

Since the complete comprehension of this phenomena is impossible at this time, we do, however, postulate the following

In the presence of any sound, the human being has the following natural reflexes

1 Intensifying the voice when speaking

2 Reducing the sensitivity of the ear by

  a Tensing the tympanic membrane

  b Increasing the transmission stiffness factor of the ossicles

3 The reduction in sensitivity of the ear as a whole to the response of sound at high frequency to that of any loud, low pitched, masking or interfering sound

With this in view it is possible to state that the sensitivity of the normal ear in the presence of an intense ambient noise will be reduced considerably, from the effects of the tympanic membrane and the ossicles, for frequencies below 1,500 cycles per second and from the masking effect for frequencies inclusively and particularly above 1,500 cycles per second The threshold obtained for the average normal ear under such conditions of ambient noise is, therefore, the reference plane or standard of hearing for tests in a known ambient noise field

This standard, as is any other, is absolutely arbitrary, when all the limits of the test are stipulated The comparison of the normal ear is made first with the ear suffering from pure conduction deafness which may be due to either an impediment of motion of the ossicles and the oval window, or to obstruction of the round window with complete freedom of motion of the ossicles, or to obstruction to both the round and oval windows to various degrees of magnitude, with the resultant natural reduction to the transmission of any sound of low frequency This may safely be said to be of a greater degree of absorption than that capably induced by the normal ear Hence, a greater degree of absorption of sound reaching the cochlea exists, thereby lessening the masking effect of the noise and maintaining a greater degree of sensitivity of the cochlea to the higher test frequencies

Since the standard of reference in a known ambient noise is the sensitivity of the normal functioning cochlea, therefore, an equality and even greater sensitivity to frequencies, say, greater than 1,500 cycles per second can be expected of the conductive deafened ear, while a natural reduction relative to the normal threshold will exist for frequencies lesser than 1,500 cycles per second As was observed in actual measurement the conductive deafened ear showed a practically linear decibel loss from 0 decibels at 1,000 cycles per second, to 20 decibels at 250 cycles per second and a linear decibel gain to minus 15 decibels at 8,000 cycles per second, as predicted

From the results obtained, it would appear as though the internal ear responds to intense stimuli in a different fashion than at the threshold intensity This possibly is associated with the function of the inner rods of Corti, which form part of the tunnel of the organ of Corti

When a comparison is made with the case of true perceptive deafness, the results that should occur are obvious, namely, if degeneration or complete dysfunction of the sensitized nerve endings has resulted an apparent loss or lessened response to that of the normal ear under similar ambient stimulus would be present. In general no effect should show in the response to the lower tones as the tympanum and ossicles are functioning normally until the degenerative damage extends to involve the low frequency reception of the cochlea Since the number of cases of true perceptive deafness at the disposal of the laboratory for purposes of testing were limited, the confirmation of this theory is only approached from the results available The actual measurement necessary in such a procedure under the condition of a loud ambient noise for any case of perceptive deafness, is difficult due to the pain developed, the recruitment effect and the retention through out the entire test of the undivided cooperation of the patient, therefore, the existence of paracusis can only be expected of persons suffering from some form of bilateral conductive deafness and can be stated as being of an apparent condition only, since such a person is basing his comparison in terms of a normal functioning cochlea of some arbitrary reference sensitivity At low intensities the reference sensitivity of the cochlea of both normal and abnormal are alike, but due to the absorption to sound transmission by the conductive abnormality, an appreciable hearing loss or difference in threshold exists relative to the normal ear as a whole, under similar conditions At high noise intensities another but a lesser degree of sensitivity of the cochlea prevails for the normal ear to that in the quiet, while in the abnormal ear this lowering change in sensitivity is not so great as that of the normal ear, however, the ears of both have apparently the same degree of practicable overall sensitivity under the condition of an intense ambient noise As the ambient noise is reduced to zero magnitude, the normal ear appreciates the change in intensity of the ambient noise without realizing the change in overall sensitivity which takes place, since the rate of change of sensitivity is quite small The abnormal ear, on the other hand, realizes not only the change in intensity, but also the overall change of sensitivity required to render the ambient noise inaudible, therefore, the rate of change of sensitivity is sufficiently great to be appreciated The converse of this applies equally as well Such abnormal ears, therefore, do have an apparent increase in sensitivity from the quiet to the noisy ambient, whereas the normal ear does not have any apparent change in sensitivity

Attention should be drawn to the saturation effect that can be expected to be reached for all types of ears when ambient noise is increased further and further Prediction of the intensity of the ambient noise which would produce this saturation effect is that intensity of noise which would cause pain in the normal ear An optimum, therefore, likely exists as far as the paracusic is concerned

CONCLUSIONS

The following conclusions may therefore be drawn

1 Paracusis does exist.

2 Paracusis is to be found only in people suffering from some form of conductive deafness

3 The conductive deafened ear responds equally as well, if not better than, the normal ear, in the presence of an intense noise field for tones above 1,500 cycles per second with a slight loss below 1,500 cycles per second

4 The rate of change of sensitivity of the abnormal conductive deafened ear relative to the normal ear is large, between the respective thresholds for the test sounds in the quiet to the same sounds in an intense ambient noise field

5 An optimum of pure conductive deafness as observed, for example, clinically in otosclerosis, will afford the greatest possible change, or the extent of the increase in sensitivity observed by the paracusic.

6 An optimum exists relative to the magnitude of the ambient noise field intensity that may be applied to the paracusic before a reduction in sensitivity of the ear occurs

7 Paracusis is unobserved by the ear afflicted with perceptive deafness, as the reduction in overall sensitivity is not appreciated any more than in the normal ear

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ADULT TONSILLECTOMIES USING PENTOTHAL SODIUM, CURARE, PONTOCAINE AND NOVOCAINE AS THE ANESTHETIC *

FORDYCE JOHNSON, M D ,
Pasadena, Calif

A paper on "The Use of Sodium Pentothal Anesthesia in Adult Tonsillectomies" was presented before the Eastern Section of the Triological Society, January, 1949, at Boston, by Irl H Blaisdell[1] His report stimulated our interest in this new technique As a result of certain modifications, the combined opinions of both anesthetists and surgeons, the following procedure has been devised as presented in this paper

The adoption of a new technique or a modification of an old one is at times an extremely difficult accomplishment, however, any procedure which will reduce the incidence of complications to the patient and make an otherwise major procedure easier and safer for the surgeon should have its merits

The gravity of tonsillectomies both as to morbidity and mortality is rapidly declining, due to improvement in surgical technique and postoperative care Flick and associates,[2] reporting in 1929, stated that in 172 cases of pulmonary abscess, 120 patients, or 70 per cent, were postoperative The abscess in 97 cases, or 57 per cent, of the series appeared after tonsillectomy In 1938, Morrison[3] stated 20 to 30 per cent of all cases of pulmonary abscess were due to tonsillectomies

The presence of aspirated blood in tracheal secretions was shown by Hara,[4] also by Steele and Anderson,[5] in 100 per cent and 96 6 per cent, respectively, in their series of tonsillectomies with the patient in the supine position Contribu-

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*Read at the Fifty-sixth Annual Meeting of the American Laryngological Rhinological and Otological Society Inc Toronto Canada, May 22 1952

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ting factors toward this finding could have been inadequate suction during the operation, and unskilled assistance in depressing the tongue Using the procedure to be outlined, we have had less than 1 per cent of the patients with blood in the tracheal secretions at the termination of surgery

During the past three plus years 189 adult patients (14 years and older) have had tonsillectomies in which sodium pentothal, curare, pontocaine and novocaine was the anesthetic. It has been surprising, the alacrity with which these patients choose sodium pentothal as the anesthetic when given their choice. The features which please the patient are the lack of fear of fighting the anesthetic, either ether or local novocaine, their desire not to participate in the operation, and their fear of suffering pain during the operation The additional features of no nausea or vomiting and a quiet postoperative period is appreciated by the patient.

For the surgeon the desirable features are rapidity of induction, for the patient is asleep in less than 30 seconds. The throat is perfectly quiet during the operation, there is no straining there is less bleeding, there is no limit to the amount of suctioning one may wish to do, for there is no anesthetic being withdrawn

Features of the technique which have made this operation less of a strain to the surgeon include sitting at the head of the table, the use of the Goode headlight, tilting the operating table from a level to a head low position of 10 degrees and the additional hyperextension of the head. The use of the Davis Crowe or the McIvor mouth gag is desirable

Sodium pentothal was first introduced in 1934 Its use in throat surgery became popularized about 1945 when it was used alone,[6,7] later with nitrous oxide,[8,9] and with cocaine,[10] but always with intubation Curare was added, as reported by Robinson,[11] who found that curare decreased the reaction time from an average of 75 minutes to 25 minutes and less. Blaisdell[1] stimulated renewed interest in this subject

In a recent report Dillon[12] states that sodium pentothal is a somnifacient and should be considered as such It is not an

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In a recent report Dillon[12] states that sodium pentothal is a somnifacient and should be considered as such. It is not an anesthetic in the true use of the term, for it does not have the additional properties of analgesia For this reason it is most important to use a local anesthetic, especially when operating in the oral and pharyngeal areas

By the addition of pontocaine and novocaine as a local anesthetic to the above procedures we have eliminated the use of the endotracheal tube Where the procedure is carried out meticuously there has been no laryngospasm In this series of cases laryngospasm has not been present

Preoperative Medication This procedure is only used on patients over 14 years of age Patients 14 to 17 years of age are given atropine sulfate 1/300 gr (0 2 mg) and morphine sulfate 1/8 gr (8 0 mgm) hypodermically, adults are given morphine sulfate 1/6 gr (10 0 mgm) and scopolamine hydrobromide 1/200 gr (0 3 mgm) hypodermically 30 to 60 minutes preoperatively Atropine may be used in place of scopolamine hydrobromide

When the patient arrives at the operating room and has been transferred to the operating table, his throat is sprayed with pontocaine solution 1 per cent or 2 per cent by the anesthetist, using the Rawbotham atomizer This increases the time the pontocaine has to take effect, and also when given before the instillation of sodium pentothal lessens the tendency to laryngospasm

An intravenous normal saline solution is then started Then a mixture of sodium pentothal 2 5 per cent solution, 9 cc , plus syncurine, a synthetic curare, 1 cc is injected in the I V tubing, using several cc to put the patient to sleep, more being added as needed to control the patient It is unusual to use more than 10 cc of the mixture per patient

Within less than 60 seconds the patient is asleep The patient is draped, the head of the table is lowered so the body is at a 10 degree angle, and the Davis-Crowe mouth gag is inserted The tonsils area is injected with novocaine solution, 1 per cent, with adrenalin hydrochloride 1-1,000, six minims to the ounce of novocaine solution Usually less than 10 cc of novocaine solution is used for both sides

There are several modifications which I have adopted, that are not essential, but which, I found, are desirable. I check the adenoid area before starting the tonsillectomy, using the Hasslinger soft palate retractor and a laryngeal mirror An excellent view of the Eustachian tubes and any possible adenoid growth is thus obtained

Following the tonsillectomy and the control of bleeding the curved suction tip is inserted into the nasopharynx and the blood there is suctioned out There is usually a large sized clot in this region

An airway is placed in the patient's mouth and he is transferred back to his room He is awake within 20 minutes without the nausea and discomfort of an ether anesthetic An ice collar is placed on the patient's neck, and the care given local tonsillectomies is then carried out.

In this procedure an endotracheal tube is *not* used The danger normally encountered in the use of sodium pentothal, which demands the use of an endotracheal tube, has been eliminated. The larynx has been desensitized by a pontocaine spray preoperatively there is no foreign body, as blood or mucus, encroaching on the vocal cords, throwing them into laryngeal spasm Blood lying in the nasopharynx, the dependent part of the pharynx, does not get as high as the arytenoids The larynx is in view during the greater part of the operative procedure.

CONCLUSIONS

1 A modification of the usual routine for tonsillectomy is presented

2 The procedure consists of the use of the Davis Crowe mouth gag, the head low position sodium pentothal curare, pontocaine and noocaine as anesthesia

3 An endotracheal tube is not used

4 Using this technique on 189 adult tonsillectomies has presented no undesirable reactions

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CORRECTION

In the June, 1952, issue of THE LARYNGOSCOPE, page 577, "An Osler Item," by Harris P Mosher, M D, line 12, paragraph 1, should read "but that was all, because Dr Osler and Mrs Mosher, who went as far as London "

THE FUTURE OF OTOLARYNGOLOGY [*]

LAWRENCE R BOIES, M D ,
Minneapolis, Minn.

Four years ago in his Presidential Address before this Society Dr Lyman Richards initiated some sober thinking about the future of our specialty His thesis, "Otolaryngology in Transition,"[1] recognized the changes wrought by the advent of chemotherapy and the antibiotics, and the inroads that other fields of practice seem to be making into our specialty

Since then, others[2-4] have analyzed our status Their pronouncements in writing have indicated both optimistic and pessimistic outlooks. A few weeks ago, the general medical public had a stimulus to think about otolaryngology as a specialty because of an editorial in the *Journal of the American Medical Association* entitled "The Future of Otolaryngology"[5]

Some among us have expressed concern over the doubts this editorial will place in the minds of prospective recruits for our specialty, others seem to believe it will add to our desire for further self appraisal which will ultimately have a beneficial result. This latter group will go along with the thought expressed in the closing sentences of this editorial to the effect, "That only in a climate of continuously free and open discussion can a valid, objective assessment of the future of otolaryngology be made. Otolaryngologists have much to gain by threshing out the problem calmly and deliberately rather than by ignoring it" Dr Nash apparently had this in mind when he planned this part of the program months ago

In September, 1951, the annual report by the American Medical Association on 'Approved Interneships and Residen-

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[*] Read at the Fifty sixth Annual Meeting of the American Laryngological Rhinological and Otological Society Inc., Toronto Canada, May 22 195[illegible]

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cies in the United States"[6] indicated that one out of three of the approved residencies for otolaryngological training was unfilled Today, there is an apparent shortage of trained otolaryngologists to fill spots in group practice, or for association with an older otolaryngologist who needs help, or for one who wants to discontinue a combined practice of ophthalmology and otolaryngology and relax into the less rigorous demands of ophthalmology alone There is a tendency on the part of those older men practicing the combined specialty to advise young men against choosing otolaryngology singly as a specialty We also hear from the combined specialists in rural areas and from small clinic groups the lament that combination eye, ear, nose and throat specialists are not being trained any more

In discussing the present status of otolaryngology as a specialty, I wish to think with you about the following

1 Has the actual number now in preparation for our specialty changed substantially in the past decade?

2 The trend toward specialization has increased Has otolaryngology shared in the increased numbers entering specialties?

3 Is there need for continued specialization in ophthalmology and otolaryngology for small communities?

4 Why have other fields of practice been making inroads into our specialty?

5 What is our future?

Actual figures are available to establish the facts concerning the first two questions The following figures (see Table 1) show the number of programs approved by the American Medical Association in 1940[7] for residency training in otolaryngology, in ophthalmology, and in the combined specialty, and in addition the total number of residencies offered

Eleven years later the approved combined residency is no longer listed (There will apparently be some approved training programs of two years each in ophthalmology and otolaryngology) In 1951, the number of approved programs and residencies offered in either otolaryngology or ophthalmology were as follows

TABLE 1

1940	Approved Programs	Residencies Offered
Otolaryngology	63	173
Ophthalmology	51	131
O and O	*40*	*100*

If we count the approved programs in 1940 that were combined as the equivalent in number of approved residencies in otolaryngology, these figures indicate that in 1951 there were 47 per cent more approved programs and 49 per cent more residencies offered in otolaryngology than there were in 1940 In September of 1951, it was reported that 33 per cent vacancies existed. If 33 per cent of the 408 approved residencies were vacant in 1951 that means that 273 were filled, the exact number of approved residencies available in 1940 We do not know how many of the 273 residencies available in 1940 may have been vacant. Probably some of them were These figures do indicate however that the actual number in preparation in otolaryngology when these figures were obtained in 1951 is as large as it was a decade ago

It has been often stated that the trend toward specialization has increased Just how great this trend has been is probably not realized until we examine the figures The latest figures on approved residencies, issued by the American Medical Association are shown in the following table and compared with the figures for 1941 [4]

The report stated that in September of 1951 there were 25 per cent over all vacancies in these residencies

Some of the vacancy percentages that exceeded otolaryngology are neurology 39 per cent, pathology 39 per cent, physical medicine 58 per cent, in addition to the more limited lines of specialization, such as in cardiovascular diseases, 47 per cent, in malignant diseases, 50 per cent, and in pulmonary diseases, 45 per cent

Some additional statistics that are of interest for comparison are those related to interneships and the number of medical school graduates

A 32 per cent vacancy rate was reported in approved interneships in 1951

In Table 1 it was indicated that in 1940 there were fewer residencies offered in ophthalmology than there were in otolaryngology and there were fewer approved programs Table 2 shows that this situation had become reversed in 1951 In addition, there were 21 per cent vacancies in ophthalmology in 1951 as compared to the 33 per cent vacancy rate in otolaryngology

TABLE 2

1951	Approved Programs	Residencies Offered
Otolaryngology	152 (47% increase)	408 (49% increase)
Ophthalmology	172 (88% increase)	551 (138% increase)

The trend toward specialization has increased as shown in Table 3, but otolaryngology has not participated, relatively, in the increased numbers entering the specialties

TABLE 3

Year	No of Approved Residency Programs in All Specialties	Total Number of Residencies Offered
1941	616	5 233
1951	4 462	19 364
	(624% increase)	(290% increase)

TABLE 4

Year	No of Hospitals Approved for Interne Training	No of Interneships	Medical School Graduates
1941	735	8,182	5 275
1951	821	10 044	6,135
	(10% increase)	(22% increase)	(16% increase)

The military service demands probably have something to do with this, as it does with all other residency vacancies Table 5 shows that there were over 10,000 more physicians in military service in 1951 than in 1940

TABLE 5

Year	*Physicians in Military Service*
1940[9]	2 386
1945[10]	60 000
1951[11]	13 000

Most of us feel certain, however, that some are not considering otolaryngology as a specialty because of its alleged doubtful future.

Is there a need for combined specialization in ophthalmology and otolaryngology for small communities?

It has been my observation that the physician who specializes in both ophthalmology and otolaryngology in small communities, and in many instances in larger centers, is really a sort of general practitioner in these specialties As far as I can determine, the combination of these two fields was largely an American creation. Prior to the sulfonamide and antibiotic era this combination specialist in the smaller centers was engaged in fitting glasses, treating external eye diseases opening eardrums, doing mastoid surgery for acute disease rather poorly, and administering a great deal of treatment for nasal disorders His chief rhinologic surgery was an occasional submucous resection. He managed the anterior dislocation of the septum poorly In the laryngological area his chief surgical activity was on tonsils and adenoids Complications occurring in the disorders he treated were usually sent to a better equipped specialist in a larger center Problems of hearing loss, chronic suppuration of the middle ear and mastoid, problems of vertigo and tinnitus, the more formidable of the external ear disorders, the persistent complaints of the patient with the self-diagnosis of sinus disease the difficult appearing surgical septum problem, external nasal deformity, tumors, disorders in the oral cavity disorders with chronic pharyngeal and laryngeal symptoms, and in most cases the problems involving endoscopic procedures were usually referred to a better equipped specialist in a larger community Today the character of his otolaryngological activities has been altered a great deal because of modern chemotherapy and the use of antibiotics

The combination specialist in the larger community usually exhibited a major interest in ophthalmology or in some phase of otolaryngology and became identified with that interest A substantial majority of those combination specialists made no attempt to cover the complete fields of ophthalmology and otolaryngology and today their otolaryngological activities consist mostly of tonsil and adenoid surgery, an occasional submucous resection and the office treatment of the common ear, nose and throat complaints Many spend a majority of their time fitting glasses

Probably a typical example of this changed situation is represented in the city of Minneapolis Twenty years ago there were two men limiting their work to ophthalmology and two to otolaryngology Thirty-nine practiced the combined specialty Today in this city of over half a million population with another half million adjacent to it, there are exactly 31 specialists limiting their work to either ophthalmology or otolaryngology, and 31 who list themselves as "eye, ear, nose and throat specialists" I would estimate that 75 per cent of the work of any one of this combination group is concerned with the eye With three exceptions, none do any laryngeal or endoscopic work, few are interested in modern temporal bone surgery, the problems of audiology or medical otology, surgical rhinology, tumors, etc

Those who lament the passing of the "eye, ear, nose and throat specialist" are concerned about the absence of this type of specialist in a community the size of which apparently would not be large enough for an ophthalmologist or an otolaryngologist to practice either specialty singly

I cannot speak for ophthalmology, but I doubt that the welfare of any community is in jeopardy because this community lacks the residency of an otolaryngologist. As a rule, the combination specialist is not equipped to handle the really urgent emergencies in the field of otolaryngology, such as respiratory tract foreign body The modernly trained general practitioner can manage most of the otolaryngologic situations of a minor nature and transportation is so efficient in the present day that major problems have relatively easy access to the otolaryngologist who is well equipped

Probably a parallel situation exists in ophthalmology

It is probable, however, that there will continue to be a place in the smaller communities, at least for some time to come, for the physician who wishes to practice in the combined fields I can see no reason why he should need Board certification any more than special certification is needed for general practice. His training will probably be acquired largely as it has been in the past. It was usually based on an experience in general practice supplemented by intensive short courses in various aspects of the two specialties

Why have other fields of practice made inroads into our specialty?

The two activities in our specialty that are usually mentioned first when we decry the seeming invasion of our field of work are tonsil and adenoid surgery, and bronchoscopy Now, tonsil and adenoid surgery has always been a part of general practice and it is in the domain of one who calls himself a general surgeon. If figures were available I wonder if these would show that it is the general practitioner or surgeon who has actually reduced the number being done by the otolaryngologist. Certainly the public has become more specialist minded if those figures showing the trend toward specialization in the past decade have any meaning In some communities it is true that the pediatrician has taken up tonsil and adenoid surgery and this is an inroad I doubt that this will spread I know of no teaching institutions associated with medical schools where the pediatric training embraces tonsil and adenoid surgery, and I doubt that it ever will as long as a respected otolaryngologist is on the job As a rule specialists in other fields who are true specialists recognize the fact that the lymphoid tissue of the pharynx should be better managed in relation to the health of the upper respiratory tract by a well trained and experienced otolaryngologist than it can be done by one to whose activities this is just a sideline

Perhaps there is less tonsil and adenoid surgery to do because the indications have been reduced The theory of focal infection is not all that it was thought to be 25 years ago Neither does infection carry the same hazard because of the safety that chemotherapy and the antibiotics have brought

One thing that does bother me, however, is the fact that there are busy otolaryngologists who welcome the opportunity to rid themselves of the doing of this surgery, even though they wish to continue being known as throat specialists If tonsil and adenoid surgery is better done by the specially skilled, then why not continue to retain this responsibility?

It is my personal conviction regarding the matter of invasion of the field of endoscopy by the chest surgeon or internist that when this has occurred it has in many instances been a matter of a situation in which the assistance furnished by the otolaryngologist has been inadequate to these other specialties I want to cite a personal experience in this regard It offers a solution to some of these problems

Twenty years ago at the University Hospital in Minneapolis, there was dissatisfaction in the medical and surgical departments in the matter of getting prompt diagnostic procedures performed in the field of bronchoesophagology The surgical department then sent one of their staff away to learn the technique of pulmonary and esophageal endoscopy After he came back and was getting in our way, we decided that we were better equipped than he was We began a campaign of talking, demonstrating, offering to be right on the job when emergency situations arose (and these were quite common in chest surgery before modern anesthesiologists were available) and in the course of a very few years our competition practically vanished

A similar situation was present when the otolaryngological service at the Minneapolis General Hospital was taken over by our department at the end of World War II Dr Robert Priest is in charge there, and by offering a superior endoscopic service we have practically recovered this work which was being done by an internist. Similarly, the endoscopic work at Ancker Hospital in St. Paul one of our affiliated services has been captured from a chest surgeon by Dr Jerome Hilger and his associates, Dr Hochfilzer and Dr Goltz.

Now, I do not mean to imply that the otolaryngologist should try to stop the chest surgeon from doing bronchoscopy The latter, if he is equipped by training and experience to do bronchoscopy, should use all the means that he can personally to make an accurate diagnosis for himself, however, the fact that chest surgeons do their own bronchoscopy is not going to end this activity for otolaryngologists In the first place, the number of chest surgeons will obviously be limited It is only in the larger cities that one can exist in this specialty I have a notion that the chest physician who is not a surgeon will continue to prefer the services of the otolaryngologist who has demonstrated his special skill in technique, a knowledge of chest pathology and bronchographic interpretation and the fact that he carries a stethoscope in his pocket and uses it I am sure that the chest surgeon in teaching institutions is not going to do bronchoscopy unless the department of otolaryngology falls down on the job

In some of these discussions about our changing status and the future, it has been claimed that other specialties are also invading our field The allergist, the maxillofacial surgeon, and even the psychiatrist are mentioned I disagree with these ideas

Allergy is a relatively new specialty, but otolaryngologists slept with the idea that all rhinitis was due to infection, while voices like those of Hansel and others at one time fell on rather deaf ears Today, we know that the otolaryngologist who develops an interest in the allergic problems of our specialty does a much better job of managing these problems than do the allergists who seek to go alone

Maxillofacial surgery as a specialty has always been, I believe, extremely limited Most, if not all, of those who practice it as a specialty exhibit degrees in both dentistry and medicine Facial injuries, tumors of both jaws and of dental and oral cavity origin, and cleft palate work comprise their field Some include a certain amount of facial plastic surgery I can't see where they have necessarily invaded our specialty, but I also can't see why the otolaryngologist who is interested should not equip himself to care skillfully for the work done by the maxillofacial surgeon No one can be critical of the otolaryngologist who knows what he is doing and does a good job

The psychiatric angle to this usurpation is even less apparent Otolaryngologists worked a long time before waking up to the fact that nasal stuffiness, many forms of head pain, certain throat symptoms, etc , are often not the result of primary disease at these sites that I have mentioned The competent otolaryngologist of today may not be doing as many surgical procedures as he might be doing if he was unaware that psychiatric factors play a rôle in a number of symptoms within our field of activity In that sense, the former degree of surgical activity has lessened a bit, but it seems only proper not to accuse the psychiatrist of invading our field, but rather to blame ourselves for our shortcomings

What is our future?

At the 1951 meeting of the Teachers' Section of the Academy, this question was raised, "Have the Opportunities in Otolaryngology Increased or Decreased in the Past 15 Years?"

Dr Howard House spoke for otology, Dr Jerome Hilger for rhinology and Dr Howard McCart for laryngology Each reviewed the present day activities in his field and concluded that the possibilities are so numerous for the broadly trained otolaryngologist that, singly, he had difficulty in adequately covering our specialty These discussions are to be published in the next issue of the *Transactions* of the Academy

I am sure that most of you will agree with these conclusions But now comes "the $64 question" where is one to get a training that will equip him adequately in the various activities which we now regard as part of our specialty? Unfortunately, there are not enough institutions where such training can be obtained. Lierle[13] commented on this at the meetings in San Francisco in 1950 when he said

'The most glaring deficiency in our training seems to be lack of uniformity in the scope or field of otolaryngology in our teaching institutions The Board of Otolaryngology required that candidates be examined in all phases of otolaryngology, peroral endoscopy, maxillofacial surgery, and surgery of the neck exclusive of the thyroid gland It has been revealed that only one-half of the institutions teach the entire field of our specialty In a number, the operative procedures consist merely of tonsillectomies and submucous operations

I think the future of otolaryngology is in the hands of the country's teaching institutions."

This last statement of Lierle s, to my mind, sums it all up in a single sentence Let us therefore, take a look at the composite picture and think about the following

1 The grass roots of our specialty are in the undergraduate students We urgently need improved teaching programs in many of our universities The Teachers Section of the Academy has adopted minimum standards for this. We need missionaries for this work, but these must and should be found through initiative at a local level

2 Where a high level of undergraduate teaching is found, there also will be found or will develop a good graduate program The combined appraising facilities of the American Medical Association, the American College of Surgeons and the Board are reviewing the programs for residencies. Approval will be limited to those institutions where an adequate three-year program of graduate training can actually be offered within that institution or its affiliations Some protest that a three-year training program is too long Those who protest would probably be the first to insist that our specialty requires as much specialized knowledge as a well trained surgeon or internist must have Superior preparation in those specialties requires as much and usually more than can be obtained in a three-year residency

3 These objectives are not to be gained overnight At least 10 years will pass and probably a second 10 years before a sound basic program of undergraduate and graduate instruction will be attained in a majority of our institutions When this has been accomplished, we need have no apprehension about the flow of talent into our residencies or about the regard that other specialties have for us Again quoting Lierle "If we attain excellence as specialists, we need not concern ourselves about what others do in our particular field"

I close with a statement made by Gordon Hoople [13] "Surveys critical reviews, those are all-important, but far outclassing them is the job we ourselves have got to do"

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MALIGNANT DISEASES OF THE PARANASAL SINUSES WITH A CASE REPORT OF PRIMARY CARCINOMA OF THE ETHMOID LABYRINTH COMPLICATED BY NASAL POLYPOSIS[*][†]

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Malignant diseases of the paranasal sinuses are now not infrequently reported in the otolaryngological literature. This is due to our alertness and improved diagnostic methods. The incidence for malignant tumors of paranasal sinuses varies with reporting authors. According to Watson[1] there was 0.44 per cent of paranasal sinus cancer among patients admitted to the Memorial Hospital in New York within 10 years. Ewing[2] is of the opinion that neoplastic diseases of the nasal passages and accessory sinuses are of frequent occurrence, and that about 2 per cent of all cancer cases are in this area. The same author in the review of a large number of malignant diseases found that 1.84 per cent occurred in the antrum of Highmore. Seelig[3] states that in a series of 2,724 patients with cancer, admitted to the New York City Hospital from 1935 to 1946, there were eight cases, or 0.22 per cent, of carcinoma of the maxillary sinus. In Ringert's[4] series the nasal cavity was involved in 49 per cent of the cases, the ethmoid labyrinth in 43.1 per cent, the alveolar process in 45.4 per cent, the orbit was invaded in 22 per cent, and the antrum of Highmore was involved in all instances.

According to Watson[1] the maxillary sinus is five times more susceptible to cancer than the other sinuses combined. The ethmoid sinus is next most frequently involved, the frontal and sphenoid being less frequently engaged in the order mentioned.

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[*] Read before the Medical and Surgical Staff, Yorkton General Hospital, Jan. 29, 1952.

[†] From the Yorkton General Hospital.

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The commonest malignancy encountered in this region is a squamous cell carcinoma. Geschickter[3] found that squamous cell carcinoma of the nose and its accessory sinuses rarely develops in patients under 40 and is most frequent in the fifth to seventh decades The youngest patient in his series was a 15-year-old girl In Watson's[1] series, a boy of four years Males are more susceptible than females Fabricant[4] found that malignant tumors of the paranasal sinuses are seven times more frequent in the male than in the female

REPORT OF A CASE.

The interest in the case being reported was aroused by the combination of malignancy of the ethmoid sinus with nasal polyposis which masked the serious primary lesion Unanswered questions remained as to whether a nasal polyp developed into malignancy and whether the ethmoid labyrinth was primarily or secondarily involved as was the orbit

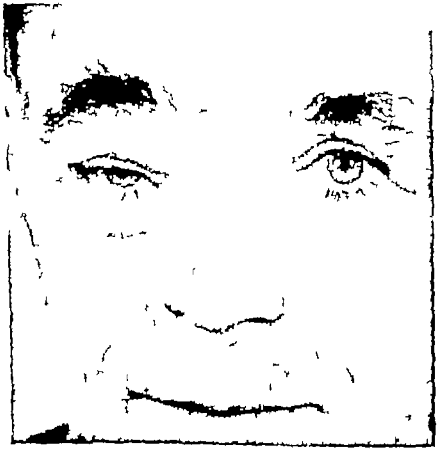

Fig 1 Preoperative photograph showing the swelling of both right eyelids, reduction of the palpebral fissure shifting of the right eyeball and bulging of the area of right inner canthus

The patient was a 37 year old, well developed and well nourished man referred to me in April, 1951 The presenting features were nasal obstruction and swelling of the right eye He gave a histo painless gradually increasing obstruction of the right nostril with whitish yellow never bloody discharge The growth of the obstru was slow developing over a period of two years This was assoc

Left.

with mild dull headaches, varied in intensity and frequency, lim mostly to the right frontal region coming on in spells for one hour easily relieved with aspirin In January 1951, he noticed a definite sw ing of the right eye, which was tender on palpation Four weeks prio his office call the patient complained of blurred vision especially w *reading This was accompanied* with lacrimation of the right eye diplopia was noted

Appendectomy in 1936 was the only significant item in his past med history No childhood diseases were recalled No history of inj Family and social history irrelevant He has lost no weight On ex nation the patient was cooperative and his general physical condition good The significant findings were confined to the right nasal cham and right eye The right nostril was packed with numerous pink gray shiny not bleeding on touching nasal polypi which completely obstruc the right nasal airway

The nasal polypi were protruding between middle and inferior turbinates and covered with mucopurulent discharge. The inferior turbinate was hidden by the polypi The nasal septum was deflected to the left. The left nasal chamber appeared to be normal with normal olfaction No offensive smell. No tenderness on palpation over the right maxillary sinus some tenderness over the right side of the nasal bridge The nasopharyngoscopic examination was negative in all respects. The hard palate was normal in appearance as well as on palpation. Transillumination of the sinuses disclosed a very dense right maxillary and frontal sinuses all other sinuses being clear

Right.

Fig —. Two Roentgenograms showing markedly increased density of the right frontal ethmoid, and maxillar sinuses and the right orbit. The films also demonstrate the extensive erosion and destruction of the superior nasal quadrant of the right orbital margin roof of the orbit, and anterior plate of the right frontal sinus

Right Eye Both upper and lower lids were edematous, and the palpebral fissure reduced markedly No considerable exophthalmos could be visualized, but the eyeball was deviated downward and somewhat outward and depressed Pain and tenderness on palpation round the inner half of the right orbital margin In the orbit a firm but resilient mass contiguous with bone was palpable extending along its internal wall and being most prominent near the inner canthus and along the roof of the orbit. The pupil was circular and central and equal with the left one Its reactions were normal The extraocular movements in all planes were intact Fundus examination indicated no abnormalities Vision without correction, 20/100 *Left eye* normal

The results of the physical examination were otherwise within normal limits with palpable but not enlarged right sided lymph glands of the neck. Routine laboratory work irrelevant, serologic tests for syphilis being negative

Diagnosis In search for the diagnosis two X ray films of the accessory paranasal sinuses were taken in Yorkton General Hospital and described by Dr L C Hacking as follows "There would appear to be marked increased density affecting the very large right frontal sinus, ethmoid area antrum, and orbital cavity on this side How much of this may be due to the tumor process and how much due to secondary inflammatory reaction I am unable to determine from the films or, indeed, radiologically from any other method There would seem to be extensive erosion and destruction of a large portion of the superior nasal quadrant of the right orbital margin and including portion of the roof of the orbit and probably anterior plate of the right frontal sinus The extent of the area of destruction cannot be definitely determined from these films "

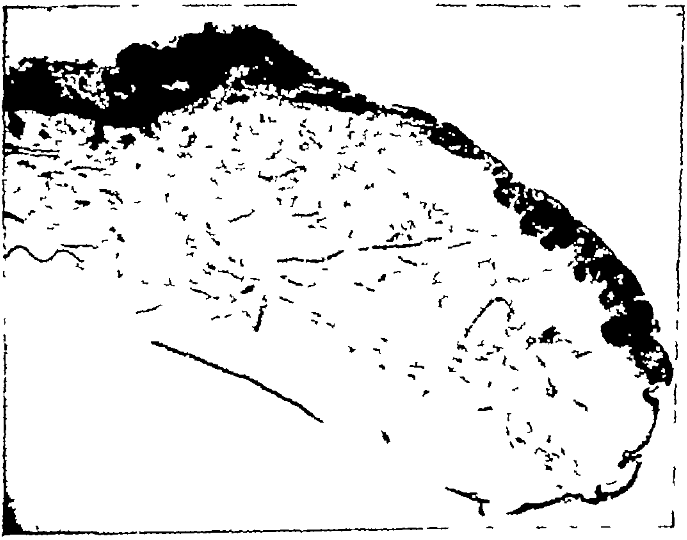

Fig 3 Histological section of the polyp covered on one surface by pseudo stratified transitional epithelium and on the other surface by epithelium of more squamous type

For diagnostic purposes and in order to establish drainage of the affected sinuses a right nasal polypectomy was performed About 15 polypi were removed from the right nasal chamber The nasal polypi originated from the right middle meatus and middle turbinate This turbinate appeared to be soft, fragile and rugged Its anterior pole was partially

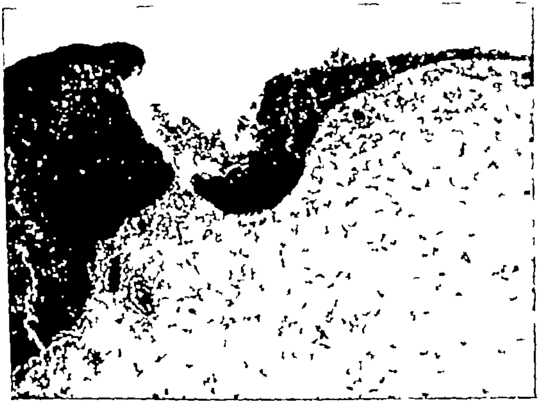

Fig 4 Microscopic section of higher magnification of the same polyp giving more detail.

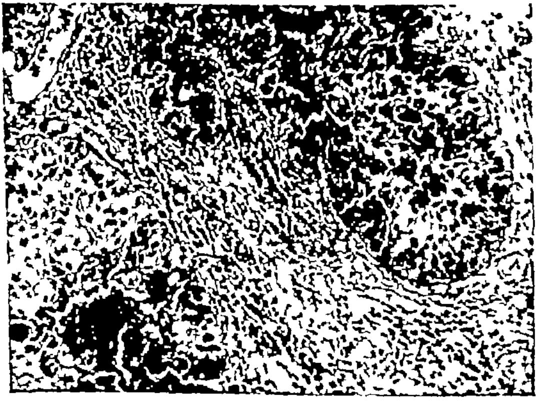

Fig Section of the roughened surface of the same polyp The histopathological diagnosis given was epidermoid carcinoma with invasion of the stroma by the malignant epithelial cells.

amputated and the bulla ethmoidalis opened Thick yellow greenish purulent discharge was encountered in the ethmoid labyrinth. This operation was accompanied by heavy bleeding which stopped under tamponade One of the removed nasal polypi had a deep red hard and rough surface its other surfaces being grayish pink, elastic and smooth, as in normal polyps The pathologist's report (Dr J D Stephen) was as follows Gross description "Specimen consists of several pieces of mucoid polypoid tissue The largest measures 3 cm in length and 1 5 cm in diameter and has an irregular warty surface Microscopic description 'This is a nasal polyp covered on one surface by pseudostratified transitional epithelium and on the other surface by epithelium of a more squamous type The roughened surface noted on the gross examination proves on histologic examination to be an area of epidermoid carcinoma with invasion of the stroma by the malignant epithelial cells

As the diagnosis of malignancy was thus established further differential diagnosis from orbital periostitis and cellulitis, osteomyelitis of the forehead from frontal sinus infection, pyocele orbital abscess, benign nasal growths, tuberculosis rhinoscleroma and Boeck s sarcoidosis became unnecessary Syphilis was excluded by negative serologic tests Although it was important to locate the primary site of the malignant growth in our patient, this was difficult and uncertain because of the anatomy of the part involved and late stage of the malignant disease

According to Capps[7] primary malignant neoplasm occurs only in the maxillary and ethmoid sinuses, but the site of origin is usually uncertain because when the malignancy is diagnosed it has already extended far beyond the primary site

The symptoms of cancer of any paranasal sinus are those of advanced disease and may consist of headache, unilateral nasal obstruction, unilateral nasal discharge, epistaxis, swelling of the cheek and palate, edema of the eyelids, displacement of the eye (proptosis), epiphora and diplopia The differentiation as to the site of primary lesion is not easy Schall[8] is of the opinion that the symptoms of the malignant growth in the antrum of Highmore depend upon the location of the tumor If it originates in the hard palate or the superior alveolar process there is swelling of the palate, loosening and falling out of the teeth and even fistulization into the antrum If the malignant growth originates from the posterior superior antral wall there is paresthesia or anesthesia of the cheek of the affected side None of these specific antral symptoms were noted in our patient, and as the puncture of the antrum, performed after polypectomy,was negative we may assume that the maxillary sinus was not the primary site of the malignancy The haziness of the same sinus seen in the X-ray films may be attributed to an inflammatory reaction More detail could be obtained by cytologic study of washings from the maxillary sinus advocated recently by Fitz-Hugh and Moon and Lupton[9] Robinson[10] points out that aspiration biopsy is helpful when the pathologist is sufficiently experienced to evaluate the results of the cytological technique

Schall[8] indicates that when cancer is superimposed upon polypoid ethmoiditis it may be suspected if there is heavy bleeding after polypectomy Tumefaction at the upper and inner part of the orbit, edema of the eyelids, downward and outward displacement of the eye globe and lacrimation soft, fragile anterior pole of the right middle turbinate and bulla ethmoidalis, heavy bleeding during the operation and the X-ray picture point in our case toward the ethmoid labyrinth as the primary site of the epidermoid carcinoma which invaded the nasal cavity and the orbit

PATHOLOGY

According to Barnhill,[11] The pathology of these tumors in the nasal accessory sinuses is the same as that of malignant tumors found elsewhere. In carcinoma the infiltrating cells arise either from the surface or glandular epithelium As infiltration progresses, and frequently the invasion is slow, the adjacent bone and soft structures become involved, causing ulceration and destruction of tissue" If and when the nasal polyp became malignant in our patient is impossible to ascertain The malignant growth may have the appearance of an innocent nasal polyp which on histopathological examination happens to be epidermoid or other carcinoma In Evans' (from Ewing[2]) opinion we know little about the relation of nasal polyps to malignant neoplasms

What is more important, there is no definite limit between nasal polypi which arise from chronic inflammation and malignancy whose etiology is obscure

It is interesting to note that according to Ringertz[3] 30 per cent of Schneiderian carcinoma, which is a highly anaplastic cancer of the nasal passages is associated with nasal polypi Phahler and Vastine[12] state that nasal polyposis is present in about a third of the cases of squamous carcinoma, but the incidence of nasal polyposis is less frequent with squamous carcinoma than with papillary or cylindric cell carcinoma

Although nasal polypi are a pseudoneoplasm preceded mostly by chronic sinusitis, they are frequently found as a complication of malignancy like in the instance being reported The question arises whether in our case a nasal polyp became malignant and invaded the ethmoid sinus and orbit, or whether the mucous membrane of a chronic infected ethmoid labyrinth turned to malignancy, and the nasal polypi became involved in the same process per continuitatem True malignant transformation of a nasal polyp is exceedingly rare Heymann (cited from Evans[2]) found only three doubtful cases of such transformation More probably a chronic polypoid ethmoiditis is the condition which preceded the malignant process in our patient The continuous irritation and infection of the polypous degenerated mucous membrane of the ethmoid sinus and of the nasal polypi could result in malignancy

Eggston and Wolff[13] explain such process as follows The mucous membrane of a chronic infected sinus and the nasal polypi which are the product of chronic sinusitis are covered normally by columnar epithelium Because of trauma and infection the columnar epithelium may lose its cilia, the surface of the mucous membrane or polypi may become ulcerated, and metaplasia may take place from columnar to stratified squamous type with further change to epidermoid carcinoma Tumors arising in the ethmoid labyrinth may invade the orbit or vice versa, tumors arising in the orbit may invade the nasal sinuses In MacComb and Martin's[14] series of cancer of the nasal cavity, 50 per cent of the presented cases extended directly into the orbit, and in 25 per cent the invasion through the ethmoids to the floor of the orbit was demonstrated by Roentgenologic study

In our patient the floor of the orbit was intact, the malignant process being expanded from the ethmoid labyrinth to the roof and superior nasal quadrant of the orbit in the direction of the frontal sinus

TREATMENT OF PARANASAL CANCER.

A survey of available literature from 1932 to 1949 concerning treatment is given below As with cancer elsewhere in the body, treatment depends upon the nature, location and stage of the malignant process, age and general condition of the patient, presence or absence of metastases, and finally upon the attitude of the surgeon

According to Beck and *Guttman*[15] *our treatment* should vary with the histopathologic data. Highly cellular anaplastic *tumors should not be operated upon and radium* and Roentgen therapy only is indicated Houser[16] is of the opinion that surgical *procedures must be employed only to institute* adequate drainage and in order to expose the tumors of the paranasal sinuses to *direct irradiation, which is the only proper* treatment. Nash[17] outlines the typical management of a malignant disease of the paranasal sinuses This includes X-ray study with lipiodol, external opening into the sinus for biopsy, drainage and radiation with or without diathermy It is necessary to consult a pathologist as to the nature of the growth and prognosis. Breeding[18] recommends intranasal, external or palliative surgery in 'not hopelessly inoperable" cases to be followed by radium and Roentgen therapy and diathermy For intractable pain — intracranial division of the Vth or IXth nerves

MacComb and Martin's[14] scheme of treatment includes general hygienic measures high voltage Roentgen radiation of the sensitive primary lesion surgical treatment of the radioresistant original lesion when irradiation alone is inadequate, postoperative high voltage Roentgen radiation, treatment of recurrences and treatment of metastases. Watson[1] advocates surgical removal of a small localized cancer of a paranasal sinus if it is discovered early and if there is a reasonable assurance of further tumor control In moderately advanced cases either radiation by interstitial radon, followed by cautery excision of the tumor and involved bone, is advisable, or external Roentgen treatment with surgery, restricted for the establishment of drainage or for control of hemorrhage, is indicated In desperately advanced cancer of the paranasal sinuses only drainage conservatively established is necessary Schall[8] believes that adequate drainage should be established independently of which type of treatment is employed because the patient with proper drainage suffers less during radiation In an anaplastic tumor he advocates irradiation (external or interstitial) If the tumor does not respond to radiation, surgery with irradiation is advisable

If the orbit is seemingly involved, as it is in the case reported herein, or even when it is questionable whether or not the orbit has been invaded, Schall advocates the exenteration of the orbital contents, removal of the floor of the orbit to explore the antrum, and removal of the lateral orbital wall to exenterate the ethmoidal labyrinth and create a better access to the frontal sinus if necessary Where there is involvement of the ethmoidal and maxillary sinuses without extension into the orbit any radical sinus operation is indicated with electrocoagulation of the entire operative cavity and insertion of radium to prevent dissemination of the growth and metastases

In cases of malignant tumors of the nasal cavity in which there is no Roentgenologic evidence of bone invasion Havens and Thornell[19] advise a frontoethmoidal approach They believe, however, that the determination of the degree of malignancy is a deciding factor in selecting the treatment of choice Robinson[10] advocates radical surgery and radiation where the tumor is not too extensive and is not anaplastic For anaplastic rapidly growing tumors Roentgen therapy should precede operation Such preoperative treatment causes regression of the tumor, which may be more extensively removed during the forthcoming operation Intracavitary radium treatment should follow operation Preoperative palliative Roentgen therapy is indicated in the advanced cases Chemotherapy and frequent irrigations are invaluable in controlling secondary infection and bone necrosis

Abdeen[20] feels that the choice of treatment is of lesser importance since surgical excision and radiation used alone or in a combination give in most instances the same final bad results due to the reappearance of the primary visible and secondary invisible lesion

Schall and Brewer[21] have found in cases with superimposed acute infection the following treatment to be effective Roentgen radiation supplemented when necessary by surgery for drainage and large doses of antibiotics and chemotherapy The treatment of the recurrence of the primary tumor is only palliative Finally, Capps[7] believes that "pure surgery is now a thing of the past.' Nowadays diathermic cutting and coagulation surpass surgery If the orbit has been invaded it should be exenterated and plastic surgery employed Best results are obtained by a combination of radiation and electrosurgery The same author advocates irradiation with deep X-ray, followed by diathermy exenteration and if necessary by intracavitary radium treatment *Metastases to the lymph glands of the neck should be treated* by irradiation rather than by bloc dissection

A course of deep X ray treatment directed to the right paranasal sinuses and nasal cavity was performed on our patient in Saskatoon Cancer Clinic According to Dr C Burkell two fields were used, 10 x 6 cm. each one was directed from the right face anteriorly and the other from the right face laterally The tumor was estimated to be 8 cm deep from the face of each of these fields A total dose of 5 000 Roentgens was applied in this three-week course of treatment The maximum skin dose was 5,100 Roentgens The skin reaction was moderate with moist desquamation. Three and one-half months after completion of the treatment the skin of the treated area was well healed with tanning The patient had no trouble with his right eye except tearing and loss of lashes, his right nasal passage being clear with no discomfort The regional lymph nodes were not enlarged and the general condition of the patient was satisfactory (Dr A G Genereux)

COMMENT

In conclusion I believe that in the case presented the primary site of origin of the epidermoid carcinoma was the right ethmoid labyrinth and that the malignant disease was complicated by nasal polypi rather than a nasal polyp turned to malignancy We could also presume that this epidermoid carcinoma of the ethmoid labyrinth was associated with ethmoidal sinusitis, polypoid in nature In making a proper diagnosis the radiograms were suggestive only and not conclusive, since in a Roentgenogram the neoplastic and nonneoplastic masses cannot be differentiated The only suggestive sign of malignant diseases in the Roentgenogram was erosion of bone Extensive erosion of a large portion of the superior nasal quadrant of the right orbital margin and portion of the orbit indicated invasion of the orbit, but it did not necessarily mean that the process was neoplastic The symptoms of early malignant disease in this site did not differ probably from those of chronic polypoid ethmoidal sinusitis, and this is the reason why here an earlier diagnosis of malignancy could not be hoped for

Surgical exploration was attempted in view of the destruction of the orbit seen in the Roentgenogram Profuse bleeding during the operation, fragility of the bulla ethmoidalis, and suspicious macroscopic appearance of one of the removed polypi directed the diagnosis toward malignancy, but the true nature of the disease was disclosed only by biopsy

The survey of the current trends in treatment of sinus cancer brings to the conclusion that for our patient with highly malignant tumor and extensive destruction of the adjacent bony structures the only appropriate treatment is high voltage deep X-ray radiation

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SQUAMOUS CELL CARCINOMA OF THE TYMPANIC MEMBRANE*

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Opinions differ on the frequency of cancer of the auricle and of the external auditory canal Some workers in this field of research (Peele and Hauser, 1941, Sylven and Hamberger, 1950) claim such invasive growths to be fairly rare, but according to others (Driver and Cole, 1942) and to the Ninth Annual Report of the National Radium Commission, London (1937-1938) about 3 to 5 per cent of all malignant lesions of the skin are seen in the outer ear and in the external canal

Although nothing definite is known of the etiology of cancer of the outer ear, prolonged irritation from chronic suppuration is widely believed to be a contributory cause (Towson and Shofstall, 1950) Usually the lesion is not recognized until it has involved both the external canal and the middle ear This accounts for the lack of knowledge of the point of origin of such tumors and for the apparent absence of reports of primary cancer of the drum Eggston and Wolf (1947) described two cases of malignant tumor of the tympanic membrane, but both were secondary growths In one a basal cell cancer had grown from the external canal through the drum to the middle ear In the other case a fibromyxoma had spread from the middle ear through the drum to the external canal

As the literature contains no description of cancer localized solely to the tympanic membrane, the following case report was thought to be warranted

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*From the Oto-Rhino-Laryngologic Clinic of the University of Lund Sweden

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CASE REPORT

A 70-year-old man who had a morbid fear of cancer was examined at the E.N.T. Department on several occasions. Nothing remarkable was observed until *1948 when left otitis externa was seen.* The inflammation responded favorably to the instillation of alcohol and boric acid but persistent itching was claimed. Although he was instructed not to pick or scratch the ear his mental makeup was such as to suggest that he *probably did so despite his statement* to the contrary. In September 1950 suppurating *otitis* externa *recurred* and itching became more intense. At that time both the upper quadrants were reddened as in myringitis. Boric acid was again instilled the discharge practically *cleared up but the changed appearance of the drum persisted.* A month later suppuration again recurred granulation progressed and obstructive deafness was noted. Granulation gradually advanced and in December a biopsy was done.

Pathologist's Report (Ahlström). The *excised fragments of the drum* are built up of irregular squamous epithelial formations consisting of slightly polymorphous spinocellular elements with chromatin rich nuclei and scattered mitoses. The epithelium shows a marked keratinizing tendency with the formation of beads. In some areas the line of demarcation between the epithelium and the surrounding tissue seems to be ill defined and suggestive of infiltrative growth. The *stroma is richly vascularized* and contains a dense accumulation of leucocytes. The picture does not permit a definite exclusion of epithelial atypia due to chronic inflammation but the number of mitoses, the cellular atypia and the tendency to infiltrative growth argue strongly for malignancy.

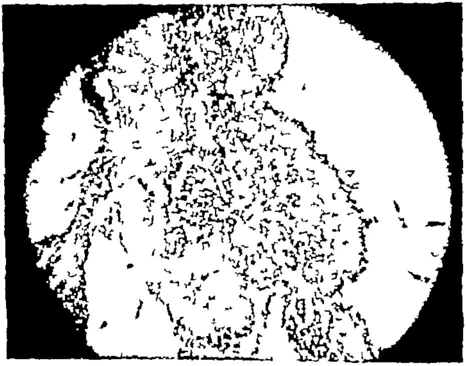

Fig. 1a. Microphotograph of a section of the first biopsy specimen removed from the tympanic membrane.

As malignancy was not certain expectant treatment was given. The granulation, which was strictly confined to the drum began to grow quickly and after 14 days biopsy was again done.

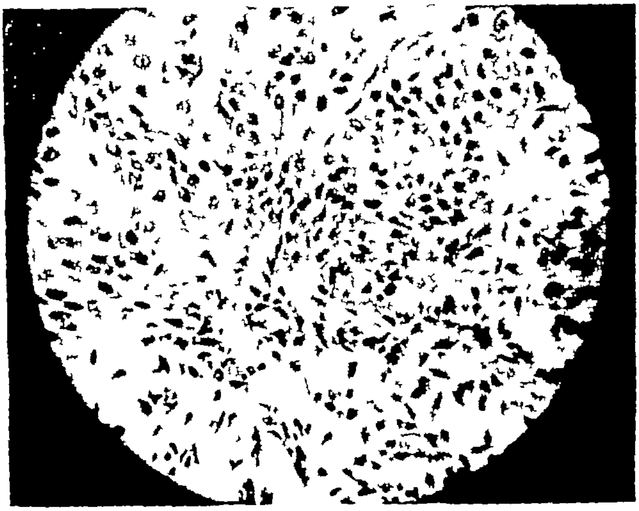

Fig 1b Microphotograph of the same section as that shown in Fig 1a, but under higher magnification

Pathologist's Report (Mellgren) The fragments of the drum show practically the same picture as before, but now the epithelial growth is richer, the atypia is more pronounced, the keratinization is more advanced, the mitoses are numerous, and the infiltrative growth is more distinct There is no longer reason to doubt the diagnosis

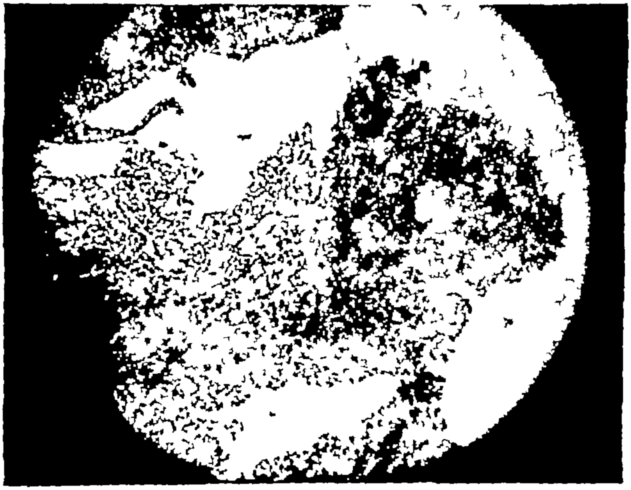

Fig 2a Microphotograph of a section of the second biopsy specimen removed from the tympanic membrane

Diagnosis Squamous cell carcinoma

As the tumor had involved only the drum preoperative radiation was not given because of the risk of radiation necrosis of the auricle and of the cartilage of the external auditory canal therefore it was decided to operate. The inner third of the external canal was removed together with the drum and the surrounding bone *en masse* Postoperatively the patient received radiation therapy Macroscopically the growth had not encroached upon neighboring parts this was confirmed at microscopic examination which also showed that it was localized to the external layer of the upper half of the drum.

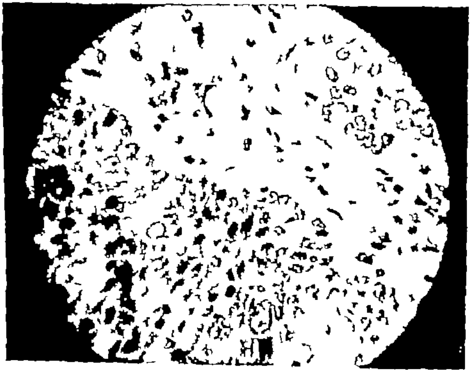
Fig 2b Microphotograph of the same section as that shown in Fig a, but under higher magnification.

In this case the lesion may probably be ascribed to continual traumatization of the drum from irritating picking of the ear The drum and the adjacent portion of the external canal were removed *en masse,* and the patient received radiation therapy postoperatively Examination one year after operation revealed a healed cavity with no signs of recurrence of the tumor

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THE REACTION OF TULLIO AND THE FENESTRATION OPERATION

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Groningen, Netherlands.

INTRODUCTION

If an aperture is made in a pigeon's osseous semicircular canal, the sound-waves give a distinct vestibular reaction This reaction is effected by the fact that the crista of the fenestrated semicircular canal is stimulated by the sound This reaction was first described by Tullio[1] Making an aperture in a semicircular canal has become a very frequent operation as a treatment of clinical otosclerosis. The question arises why, as a rule, with this fenestration, these vestibular reactions to sound cause so little or no trouble at all This question will be answered first in paragraph 1 in paragraph 2 some new particulars concerning Tullio's reaction, which are of interest for the theory of the inner ear function, will be discussed

1 Tullio gave an excellent description of the reactions after the fenestration of the various semicircular canals of pigeons. The head deviation and the nystagmus always have their course in the plane of the operated semicircular canal They are typical reactions of the crista and they continue to exist after removal of the cochlea A reaction of the utriculus can also be evoked by making an aperture in the vestibulum or, when an aperture in the semicircular canal exists, by eliminating the function of this crista by means of a careful section of the semicircular canal,[2] or, in the posterior semicircular canal by extirpation of the membranous ampulla[3] These experiments were repeated by only a few investigators Jellinek[4] Dohlman[5] Huizinga.[6]

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Tullio also ascribed a great acoustic importance to these reactions, according to his findings they are, among other things, important for the determination of the direction of the sound He thought that fenestration increased the irritability of the crista concerned, thus considerably intensifying normal reaction This explanation is certainly not correct Tullio's reaction is brought about by the fact that the aperture in the semicircular canal exists, now the sound vibration causes movement of the inner ear fluid in the vestibular labyrinth Under these abnormal anatomical conditions the crista is stimulated by sound just as the cochlea is, under normal conditions, because of the round window Tullio's reaction is proof of the importance of the presence of a second window For stimulation of the sensulae of the inner ear in general by sound, a movement of the liquor labyrinthi is absolutely necessary This very important function of the round window under normal conditions is sometimes doubted

When performing experiments on the vestibular organ of pigeons, Tullio's reaction is a very good indicator for ascertaining whether the function of the crista concerned is present As has already been remarked, the head-movements of the pigeon are very characteristic for the various semicircular canals Tullio's reaction can also be used for quite different experiments, *viz* , to inform us of the importance of the middle ear apparatus The effect of disturbing the normal sound transmission to the oval window via the drum and columella (the only middle ear bone in birds), can be determined These experiments were performed with van Eunen and Huizing[7] In the first place, they necessitated the determination of the threshold of these reactions

As the minimum response of the cochlea is determined for the various frequencies and is plotted as an audiogram, so a similar procedure is also possible for Tullio's reaction Obvious reactions were obtained at frequencies of 100 to 3,200 d v , at a higher level the reaction becomes very weak The minimum reaction was determined in this way the fenestrated pigeon was put in front of a loudspeaker through which various frequencies were presented to the ear At exactly the same distance stood the microphone of a sound level meter To the head of the pigeon a pointer was fastened, a slight deviation due to Tullio's reaction could thus be easily observed In this way a threshold curve could be made. It appears that when the thresholds in decibels obtained with frequencies of 100 to 3,200 d.v are plotted graphically, a curve of a characteristic form is always obtained The curves of Fig 1 of the three different canals are clear

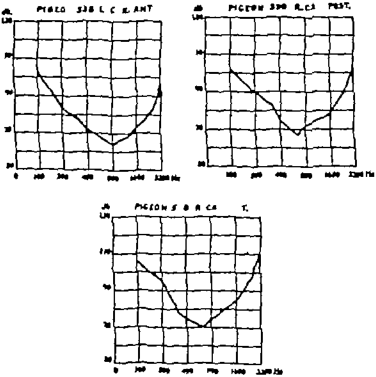

Fig. 1.

examples of it. The minimum value of the reaction with 100 d v nearly always lies in the region of 100 db and decreases rapidly with the rise of the frequency to reach at 600 to 800 d.v, the lowest point at about 70 db A prompt increase of the threshold value follows and this in such a manner that the last determination, *i e.*, at 3,200 d v, usually lies higher than the original point. The curve is the same for the different semicircular canals Fig 1 shows the threshold curve for the anterior, posterior and external canals, respectively The optimum of the reaction always lies at the same point, *viz.*, 600 to 800 d v

Tullio's reaction was quantitatively determined in 92 pigeons In 25 of these experiments extremely high values were found, the minimum lying at 80 db or higher This could always be explained by the fact that blood had entered the middle ear, thus disturbing the sound transmission, or that the aperture in the semicircular canal had turned out too large so that the function of the crista had suffered by loss of much perilymph For the other 67 pigeons the average lay at 69 db, spread between 61 and 79 db

In 20 pigeons, curves were made before and after extirpation of the eardrum This always caused a considerable elevation of the threshold for all frequencies At the optimum its average difference was 28 db, varying between 20 and 40 db Fig 2 shows an example of an experiment of this kind

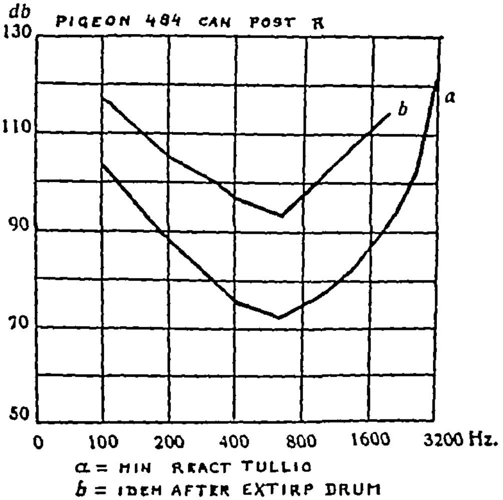

Fig 2

In this case a fistula had been made in the posterior canal of the right side Graph A is the minimum reaction for the various frequencies before the removal of the eardrum, Graph B was recorded after its removal At the optimum the difference amounts to over 20 db This experiment once more shows the great importance of the eardrum for the transmission of sound to the inner ear Obvious individual differences exist. Perhaps these also exist in man, thus explaining, beside other possibilities, the very divergent effects of a total defect of the eardrum on the hearing in man

We see, therefore, that when one of the semicircular canals has been fenestrated in the pigeon, under ideal anatomical circumstances (no infection, no labyrinth degeneration), it shows no vestibular phenomena with a sound of less than 70 db and after removal of the eardrum of less than nearly 100 db Are these values of any significance for man? The anatomy of the middle and inner ear of the pigeon shows some differences from that of the mammals and one might think that it is impossible to make comparisons. It is very important that Wever, Laurence and Smith[8] showed that in the cat removal of the eardrum and ossicular chain caused a rise in the threshold of electric response of about 28 db The values of the pigeon and the cat, therefore, are exactly the same Because of this fact, a much greater significance can be attached to these experiments on the pigeon

In the pigeon, section of the handle of the columella has the same effect as removal of the eardrum In either case the conduction apparatus to the oval window is disrupted Probably the round window under these circumstances becomes the way of entrance for the sound In all probability such is also the case after fenestration in man.

A complete restoration of the auditory function by means of fenestration is, however, impossible, as the ossicular chain, which, together with the eardrum, serves as a mechanical transformer and also as an amplifier, is interrupted The animal experiments are in complete concordance with the dissertations and findings of Walsh and Davis[9] concerning the limits of improvement of the fenestration. The mean post operative hearing loss for 69 cases of pure conductive deafness was 26 4 db A greater hearing loss must be ascribed to nerve impairment or surgical "accidents" This result of 26 4 db, therefore, completely agrees with our expectations on the grounds of theoretical considerations and from the animal experiments both on the cat and the pigeon

If we assume the relations in man to be the same as in the pigeon, then, according to these data, a fenestrated patient with an ideal history would show Tullio's reaction only at an intensity of nearly 100 db and for a few frequencies only This explains why patients after fenestration are not troubled by vertigo due to sound In reality the threshold lies still higher than the already considerable intensity of 95 to 100 db

Jongkees and Hulk[10] stated that after the fenestration operation, a clearly diminished irritability of the vestibular organ is found after rotation in the horizontal plane, this is also true of the crista externa As a matter of fact, this was to be expected Most patients are troubled by vertigo after the fenestration and show a spontaneous nystagmus that must be explained by loss of function of the crista externa This is especially so when the fenestra includes part of the ampulla, as is generally done with the new operative technique according to Lempert This strongly diminished irritability can also be shown in the pigeon by fenestration of a semicircular canal and an ampulla When this is done a much higher threshold for the rotatory reaction is found immediately after the operation Complete recovery does not always follow even after a lapse of some time

There is another point of still greater practical importance The threshold of value of 70 db in the pigeon was found immediately after making the aperture in the semicircular canal The next day the reaction considerably diminishes and then gradually disappears In the fenestration operation on man the aperture is closed with a skin flap Owing to this, the threshold will probably also be much higher

From all this it is clear why little or no vertigo is experienced with loud sound after fenestration This is fortunate, for, were the relations different, fenestration would be impossible owing to the considerable vertigo from sound We found patients with very good results after fenestration, in whom at an intensity of 115 db Tullio's reaction could not be produced The fistula test always gave clearly positive results Apparently the mobility of the new window was sufficient for stimulation of the cochlea by sound, but not for stimulation of the crista. At still higher intensities (in practice patients are not subjected to these) it must be expected that Tullio's reaction does become positive On the other hand, Benjamins[11] formerly described a patient from this clinic, having a fistula *in the horizontal semicircular canal due to* cholesteatoma but having fair hearing (whispered speech *low,* 1 5 *m* , *high,* 3 *m.*), *in whom* at an intensity of 110 db Tullio's reaction could be clearly produced After the radical operation the hearing was considerably diminished, so the sound transmission to the inner ear had been seriously damaged Tullio's reaction was negative, whereas the fistula test gave positive results

2 Investigations by Bleeker and de Vries[12] from this laboratory demonstrated that in the pigeon microphonic effects can be produced by sound from the cristae as well as the cochlea. For the various frequencies up to c. 2,200 d.v a sinewave can be produced from the crista of the fenestrated semicircular canal of the same frequency as that of the stimulating tone and differing little in size from the cochlea effect. These experiments were confirmed and largely extended by van Eyck[13] Experiments by Vrolijk and de Vries[14] demonstrated that an effect can be produced from the utriculus They could also produce a microphonic effect from the isolated *crista in pigeons* At an earlier date[3] it was shown that it is possible to remove the crista posterior in pigeons without the remaining part of the *pars superior losing its function* The opposite was also possible in a number of cases the two anterior ampullae and the utriculus were removed, thus leaving an isolated crista posterior In a series of 30 pigeons it was possible eight times to deduce a very clear microphonic effect and a weak one six times. It is not surprising that in a great number of cases after such an extensive operation (flowing away of the perilymph and endolymph) the function of the crista posterior is also damaged The existence of a crista-effect, therefore, cannot possibly be doubted any more

A strong parallelism exists between the crista-effect and Tullio's reaction: if the former is strong, then the latter is so also, if Tullio's reaction is completely absent, a crista-effect cannot be produced either. The threshold of Tullio's reaction lies much higher, however, than that of the crista-effect. Tullio's reaction begins at the optimum at c. 70 db, clear potential fluctuations usually can be deduced at as low as 35 db. The sensitiveness of the apparatus in use plays an important part. It clearly shows that a certain connection exists between Tullio's reaction and the microphonic crista-effect by comparing

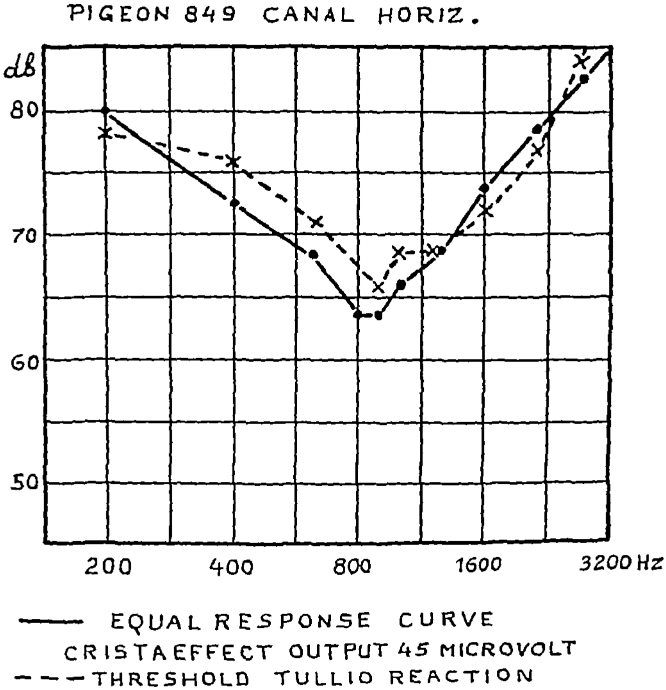

Fig. 3

the threshold curve for the various frequencies to the equal response curve of the latter. The equal response curve of the crista-effect was already described by Bleeker and in this connection was more extensively checked by Violijk. In Fig. 3, both curves of a certain pigeon are plotted next to each other The continuous line is the equal response curve for an output of 45 microvolt. The dotted line is the threshold of Tullio's reaction. The parallelism is obvious without comment.

Just as with the cochlea effect, it is still completely uncertain with the crista-effect if any physiological meaning may be ascribed to this fluctuation in potential It is quite possible that in this case we also encounter an attendant phenomenon, but just as the cochlea-effect, it certainly has its great scientific importance At any rate, the existence of this effect proves that in Tullio's reaction the crista vibrates synchronously with the frequency presented to the ear Certainly no adequate stimulation of the crista exists, owing to the origination of endolymph currents, according to Tullio Formerly, somewhat under the influence of Wittmaack's views I thought that Tullio's reaction was caused by pressure Particularly if one assumes that the influence of sound on the inner ear causes eddies, one can imagine that under these circumstances the crista is subject to pressure Now that it has been proved that the crista actually vibrates, the following explanation proposed by Dohlman is much more plausible. The crista quickly moves to and fro One might imagine that these quick movements in both directions would neutralize each other, but this is not the case, however The movement to one side has a far greater effect than that to the other side Cumulation causes the strong reactions, that, owing to the influence of sound are also possible on the crista. With the horizontal crista the ampullopetal movement gives the stronger reaction With the vertical semicircular canals this is just the reverse, the ampullofugal movement being more active This is Ewald's second law, which was actually demonstrated on the pigeon Indeed, van Eyck and also Vrolijk were able to confirm Ewald's second law for pigeons by means of electrophysiological investigations

As was described above, Dohlman's explanation of the mechanism effecting Tullio's reaction at present seems to be the most correct one This also gives a strong indication of the validity of Ewald's second law If we study the head-movements of the pigeon in Tullio's reaction it appears that, the horizontal crista being stimulated, the head moves in the horizontal plane to the opposite side (the nystagmus is homolateral) When the anterior crista is stimulated, the head moves backward, when the posterior crista is stimulated, it moves forward This is completely in accordance with the view that in the horizontal semicircular canal the ampullopetal movements gives the stronger effect and in the vertical semicircular canals, the ampullofugal one

Of late, doubts were frequently expressed as to the validity of Ewald's second law It is difficult to prove conclusively whether or not it exists in man, but with the pigeon this can hardly be doubted The corresponding results in comparative labyrinth-physiology tell in favor of the assumption that Ewald's second law also applies to man

SUMMARY

Tullio's reaction is discussed If, in test animals, the pigeon in particular, a fistula is made in the osseous semicircular canal, a very strong vestibular reaction is caused by sound, owing to stimulation of the crista The explanation of the effect of this reaction must be quite different from the one suggested by Tullio The reaction has great scientific value With pigeons it can be used as an indicator of the effect of various operations on the conductive apparatus In this way it could be shown that removal of the eardrum or section of the columella means a loss of 28 db The remarkable fact is discussed that after the fenestration operation patients are little troubled by vestibular reactions, even with loud sounds A few new points of view concerning Tullio's reaction, cleared up by the microphonic effect of the crista, are discussed Ewald's second law is certainly valid for pigeons

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LARYNGECTOMY TUBE FOR OXYGEN THERAPY *†

ALBERT H ANDREWS, JR , M D ,
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The addition of oxygen to inspired air following major surgical procedure is of recognized value in speeding recovery and preventing complications A special inner tube has been designed for this purpose, which has an extension with a side arm and cap ‡ The straight part of the extension is attached by rubber tubing to the tracheotomy type of meter mask, and the mask is pinned to the patient's gown to prevent inadvertent kinking of the tube No appreciable respiratory obstruction is produced The side arm of the tube is capped except when aspirating the trachea, thus permitting aspiration without disturbing the oxygen apparatus The tube locks in place by conventional rotating collar and may be removed easily for cleaning (see Fig 1)

During the first hour following surgery, the meter is set for "100" per cent oxygen Water is placed in the meter so as to produce a relative humidity of about 40 per cent After the first hour, the meter is adjusted for 50 per cent oxygen A heat type humidifier with long delivery tube is adjusted so that the steam is delivered close to the air intake of the meter This produces warming and high humidification of the gas This is continued for 12 hours, and then the special inner tube is replaced by the regular one No harmful effects or drying

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*Read at the Fifty-sixth Annual Meeting of the American Laryngological, Rhinological and Otological Society Inc Toronto Canada, May 22 1952

†From St Luke's Hospital Chicago Ill

‡Produced by the George P Pilling & Son Co., Philadelphia Pa.

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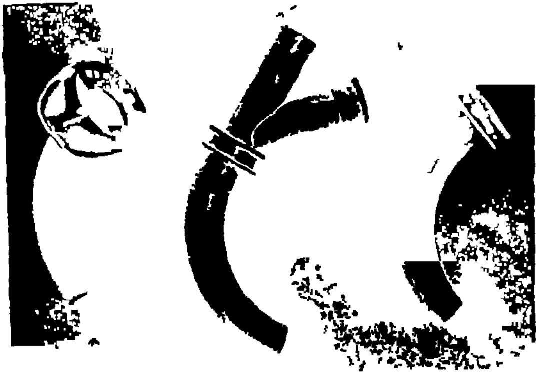
of secretions have been observed It is thought that wound healing and the general condition of the patient have been improved by this procedure.



(A) (B) (C)

Fig 1 Laryngectomy tube for oxygen therapy (A) Standard Lewis No 8 laryngectomy outer tube. (B) Special inner tube to which the meter mask for tracheotomy is attached Side arm is used for catheter aspiration with the cap removed. (C) Regular inner tube.

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION

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SYMPOSIUM

(a) — THE RELATIONSHIP OF BRONCHOSCOPY TO CHEST SURGERY *†

FREDERICK G KERGIN, M D ,
Toronto, Canada

Before discussing the matter of what the thoracic surgeon expects of the bronchoscopist in the way of help, it may be proper to inquire for a moment into the question of who should do the bronchoscopy In doing so I am conscious of the fact that I am a lone surgeon, interested in thoracic surgery, faced by a very large number of bronchoesophagologists, but, even so, I am not apprehensive, because I believe that we shall have no difference of opinion In my opinion there is no one answer to this question which is right in all circumstances In those centers in which there is an organized service for thoracic surgery, and no other surgery is done by that service the surgeons may have the time, interest and skill to do their own bronchoscopy It is probably true that the bronchoscopist who can become most expert in the interpretation of what he sees through a bronchoscope is the one who constantly can check those findings against what he sees and feels through the open chest and what he finds on studying the excised specimen in the pathological laboratory As opposed to that, there are many centers like ours in which

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†From the Surgical Service Toronto General Hospital and Department of Surgery University of Toronto

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general surgeons have too many other preoccupations to permit them to acquire the skill necessary for this work, and in which as teaching and training centers it is important to have bronchoscopy centralized in the hands of a relatively small number of competent specialists As long as these experts are prepared to think beyond the bronchus, and keep up their interest in diseases of the lungs as a whole, by frequent conferences with the physicians, radiologists and thoracic surgeons, and follow their cases through to a final pathological diagnosis, this system can function in a most satisfactory fashion for all concerned

From our point of view the functions of bronchoscopy fall under two headings — diagnostic and therapeutic I do not wish to comment on all the observations which may be made through a bronchoscope, which are well known to you — but rather to discuss their significance and interpretation from the viewpoint of surgical therapy

Under the heading of diagnosis, perhaps bronchogenic carcinoma should come first The information you may give us relates first to the question of diagnosis and second to the question of operability The ideal is actually to see the lesion and to obtain a tissue biopsy, which is always superior to a smear of secretions At the present time we are seeing about 100 patients a year with primary bronchogenic carcinoma, and of these about two-thirds are tumors arising in a major bronchus and one-third are peripheral In the first group our bronchoscopists are able to see and biopsy the tumor in a very high percentage of cases, in the second group — the peripheral tumors—the information they can give is limited to indirect observations related to the problem of operability such as bronchial compression by node or widening and fixation of the carina A survey of our cases shows that we get direct demonstration of the tumor and a bite of tissue in 60 per cent of cases, and indirect information of value in a further 20 per cent of cases It is obvious what invaluable aid this is to the thoracic surgeon

As a supplement to bronchoscopy and direct tissue biopsy, we examine secretions aspirated by bronchoscope, and also do multiple sputum examinations for cells The latter has been more productive of positive reports than the former In only 8 per cent of cases do we get a positive report on aspirated secretions when the other methods have failed It is the group of peripheral tumors, which are out of sight of the bronchoscope, which least commonly desquamate cells to be recovered by examination of either sputum or aspirated secretions, so that frequently confirmation of the diagnosis rests on thoracotomy Occasionally we use needle biopsy through the chest wall, but only in those patients in whom it seems desirable to prove the diagnosis, knowing that if the lesion is carcinoma it is inoperable, or at least incurable

With regard to diagnosis, it is sometimes asked whether a bronchogenic carcinoma ever gives symptoms in the *absence* of any significant radiographic evidence. This is quite rare I can recall two patients with such symptoms, with Roentgenograms negative even on review, in whom the bronchoscopist could see the tumor and take a biopsy, and so solve our problem.

The interpretation of bronchoscopic findings in relationship to operability requires considerable experience and close collaboration between bronchoscopist and surgeon. It is always wise to record vocal cord movements as being normal or otherwise if this is not done, there may be some doubt later We look on paralysis of a vocal cord as absolute evidence of inoperability (I may remark, in parentheses, that this does not apply to phrenic paralysis.) In assessing widening and fixation of the carina it must be remembered that other condition such as silicosis, and occasionally old tuberculosis can also cause this In doubtful cases laminograms are a useful supplement to bronchoscopy in demonstrating the cause of the widening It is important to assess carefully the visible limits of the growth in relationship to the carina. We like to divide the bronchus at least 2 cm proximal to the visible and palpable growth On the right side it is not difficult to excise some trachea, if necessary but in the case of left sided tumors the presence of the aorta makes this difficult or impossible Time does not permit a discussion of the pros and cons of palliative pneumonectomy in cases which are obviously incurable, or unlikely to be curable, suffice it to say that there is a group of patients who are ill because of infection due to a bronchus blocked by carcinoma, who will remain ill, and disabled by the infection, and die of infection long before they will die of cancer We think that palliative pneumonectomy, when it is possible, will restore these people to relative health, and allow them to carry on with some useful occupation, often for a year or even up to several years

With reference to bronchial adenomata, we do not subscribe to the belief that all of these should be treated as malignant tumors, we agree that local treatment is correct when our pathologists report the biopsy as benign and there is no evidence of metastases, providing the bronchi distal to the tumor have not sustained irreparable damage Very rarely they are pedunculated and, if so, are suitable for endoscopic treatment The great majority are sessile and show some degree of extension outside the bronchial wall, these are not suitable for endoscopic treatment, but a biopsy is of great assistance in determining their benignity If, as is so often the case, bronchograms show bronchiectasis beyond the obstruction, lobectomy, or at times even pneumonectomy is the correct treatment There is an occasional case without gross bronchial damage and only limited extension of the tumor, in which local resection of the bronchial wall, with plastic repair, is the treatment of choice

The next group of diseases to consider is the infections With respect to lung abscess, we consider that these should never be considered idiopathic until investigation, including bronschoscopy, has ruled out any cause for bronchial obstruction This means that bronchoscopic examination should be done in every case, looking for foreign body, tumor or bronchial stenosis of inflammatory origin Even if no obstruction is found, knowledge of which segmental branches is draining pus will help in localization of the abscess, in the event that external drainage becomes necessary

Unlike some other centers, we have not been impressed with bronchoscopic drainage as a method of treating lung abscess, and perhaps have not pursued this enough, however, I have seen a few cases in which even a single treatment of the bronchus, carried out through the bronchoscope, seemed to turn the corner, and an abscess which was draining badly suddenly drained freely and proceeded to symptomatic cure I do not use the word heal, because any large lung abscess produces local tissue destruction Although the infection may be overcome, there are local irreversible changes in lung, such as secondary bronchiectasis, which *remain and may or may* not give symptoms

In bronchiectasis we commonly do a bronchoscopic examination, but in the straightforward case this does not usually have any particular advantage, however, unless this is done as a routine, one will occasionally miss an adenoma or foreign body or other underlying cause for the bronchiectasis In actual fact, when bronchiectasis is due to foreign body inhaled years before, it is usually missed by the bronchoscopist because it is lying in a dilated bronchus, buried in granulations

In the management of tuberculosis it is impossible to overestimate the importance of the bronchoscope Some degree of bronchitis is present in every open case of tuberculosis, even if it be in only the tiny bronchus which is actually draining the cavity It is necessary to know if any of the major bronchi are involved before undertaking any form of collapse or excision therapy Repeated examination is essential to follow the course of healing under streptomycin therapy and to determine when surgical treatment is safe This is one special field of bronchoscopy which I think can be very well handled other than by bronchoesophagologists, the full time sanitorium staff can become extremely expert.

Occasionally we encounter broncholiths which are causing hemoptysis or symptoms of bronchial obstruction, and they can be recognized and treated by bronchoscopic examination

Time does not permit mention of the many other more rare conditions which can on occasion be recognized by bronchoscopic examination. These include the lymptomata, bronchogenic sarcoma and so on On one occasion we obtained a biopsy from a bronchus which confirmed the diagnosis of pulmonary sarcoidosis

To turn for a moment to the therapeutic uses of the bronchoscope, one thinks first of atelectasis Prevention of atelectasis, by active nursing methods and good cough discipline, is better than cure, but I believe that if it once progresses to the point when a lobe or lung has become atelectatic and airless, the time has come when the patient can no longer clear his bronchus by cough He cannot get the air into the lobe with which to cough the mucus out The answer is bronchoscopic suction at the earliest possible moment If one delays, the mucus backs up into the smaller bronchi and may reach the point where even careful suction cannot clear it and result in expansion of the lobe Atelectasis of the remaining lobe is a special problem after lobectomy for bronchiectasis, particularly in bilateral disease, and we are very alert to recognize it and lean heavily on bronchoscopy in its treatment It may be mentioned that in a very occasional postlobectomy case, in which even repeated bronchoscopic suctions could not clear a lobe and produce expansion, we have reopened the chest, milked the mucus out by massage and suction, inflated the lobe and closed the chest, with underwater drainage This has been most effective

In chest trauma, where pain and unstable chest may make cough ineffective, atelectasis is again a problem Intercostal nerve blocks and chest support may solve the problem, but at times bronchoscopy is necessary More and more, in the severe cases, we are inclined to do a *tracheotomy to permit* frequent suction When rupture of the trachea or a bronchus is suspected on clinical grounds, this diagnosis can be confirmed by bronchoscopy Immediate repair of the rupture is the correct treatment

Before leaving the question of therapy one may refer to the use of the bronchoscope as a means of insufflating or irrigating the bronchial tree with antibiotics In conditions such as bronchiectasis, the organisms in the pus lying in the bronchi are not the important ones, they are outside the body It is the organisms living and multiplying in living tissue that matter, and the best way to approach them with antibiotics is through the blood and tissue fluids Irrigating the bronchi with antibiotics in solution may improve drainage and so be beneficial, but as far as any specific antibiotic effect is concerned, it could perhaps be compared to irrigating the colon with antibiotics through a sigmoidoscope as therapy for ulcerative colitis.

This brief review has not done justice to all the functions of bronchoscopy in its relation to the surgical therapy of lung disease I hope that the succeeding speakers may suggest or fill in the gaps

SYMPOSIUM

(b) — THE RELATIONSHIP OF BRONCHOSCOPY TO CHEST SURGERY *

CHEVALIER L JACKSON, M D ,
Philadelphia, Pa

Almost 30 years ago, Chevalier Jackson (1924), at a meeting of the Section on Laryngology, Otology and Rhinology of the American Medical Association in Chicago, spoke on "Bronchoscopy as an Aid to the Thoracic Surgeon "[1] He compared bronchoscopy in its relation to thoracic surgery with cystoscopy in its relation to genitourinary surgery He pointed out the fact that in both cases both the X-ray and endoscopy were indispensable He called attention to the fact that in both fields suppurative lesions had to be treated, and endoscopic methods frequently aided in improving drainage He pointed out that in both instances biopsy of tumors was done by the endoscopic route, furthermore, in both cases, endoscopic measures were useful in pre- and postoperative treatment, and in palliative treatment of the inoperable cases When obstruction was present, whether due to foreign body, inflammatory stenosis, or tumor, it could very often be removed by endoscopic methods, and it could almost invariably be accurately diagnosed, even in cases where other measures were necessary for treatment In conclusion, it was stated that the bronchoscopist was "merely an assistant to the internist and the thoracic surgeon," except in the foreign body cases

Foreign Bodies Almost all, including many of the seemingly very difficult upper lobe foreign bodies, can now be removed by means of the bronchoscope and its auxiliary in-

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struments[2] Of course, in the rare cases of foreign body in the upper lobe, the procedure is much more difficult, and in these cases, as well as in those of foreign bodies in the peripheral bronchi, the aid of the biplane fluoroscope is indispensable.

In the case of nonopaque foreign bodies in the peripheral bronchi, such as grass heads, which have a tendency to "ratchet" themselves further and further out into the periphery, we cannot make use of fluoroscopic guidance because the foreign body is not opaque It is in these cases that not infrequently resort must be had to thoracic surgery, for removal of the foreign body by bronchotomy or by segmental or lobar resection

Tumors In bronchial tumors bronchoscopy is of great diagnostic aid, and in many of the benign tumors bronchoscopic removal is curative When the tumor is located in the larger bronchi, accessible to direct bronchoscopic vision, biopsy is easy and is carried out by means of bronchoscopic forceps Our present preference is for the type of forceps originally designed for the removal of ball shaped foreign bodies, known as the "ball forceps" In the case of tumors located beyond the range of bronchoscopic accessibility, cytologic study of bronchial secretion, the specimen being collected from the bronchus leading to the suspected area, has greatly increased the percentage of early positive diagnoses Cytologic studies are more valuable in the case of malignant tumors than in the case of benign tumors such as bronchial adenoma, but as a matter of fact the benign tumors and especially the adenomas are generally located in the accessible bronchi, and ample specimens of tissue can be taken from the tumor directly, without the use of cytologic methods

With regard to treatment, we have now come to the belief that about half of the cases of adenoma are better treated by resection of the lobe or the lung;[3] however we still strongly believe that in the cases of adenoma in which the tumor is attached by a narrow base and is readily accessible to bronchoscopic instrumentation, endoscopic removal by forceps and electrocoagulation is to be preferred (see Fig 1) In our experience we have found that very few, if any, true adenomas prove malignant or undergo malignant change Certainly this remote possibility is not a sufficient reason to advise

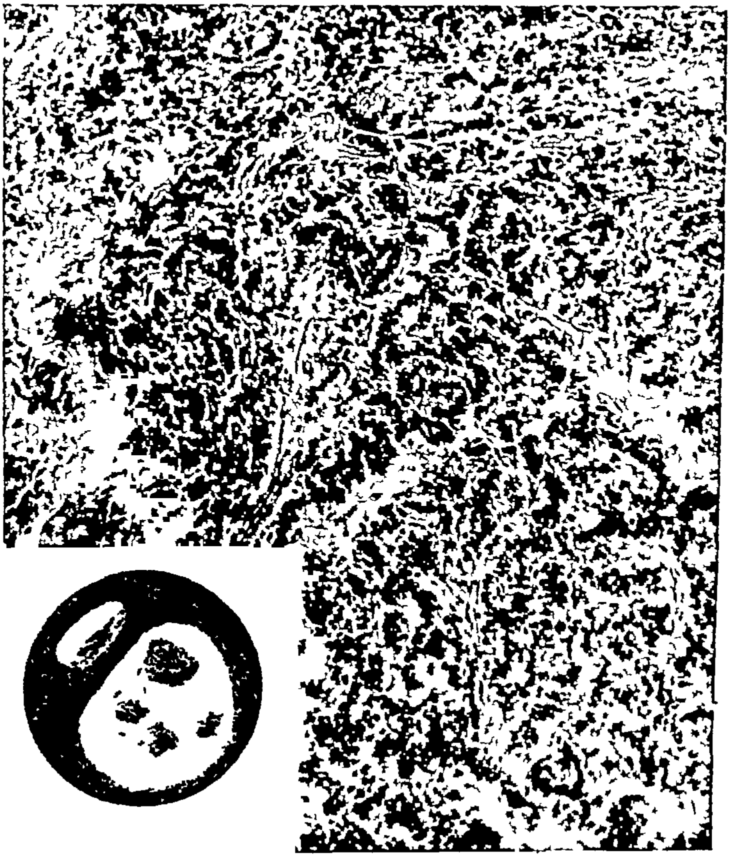

Fig 1 Typical histologic picture of bronchial adenoma of the carcinoid type Lower left gross appearance of tumor obstructing left lower lobe bronchus Endoscopic removal was satisfactory in this case.

surgical resection On the other hand, if complete endoscopic removal is not possible and there remains some narrowing of the bronchus, due to either collapse or compression, and if there is any bronchiectatic or other abnormality of the distal portion of the segments beyond the tumor, surgical resection is indicated (see Fig 2) One reason for the rather considerable number of cases in which endoscopic treatment has proven unsatisfactory is the fact that a considerable amount of the tumor is apt to be located extrabronchially, where endoscopic removal is obviously impossible The type of bronchial tumor

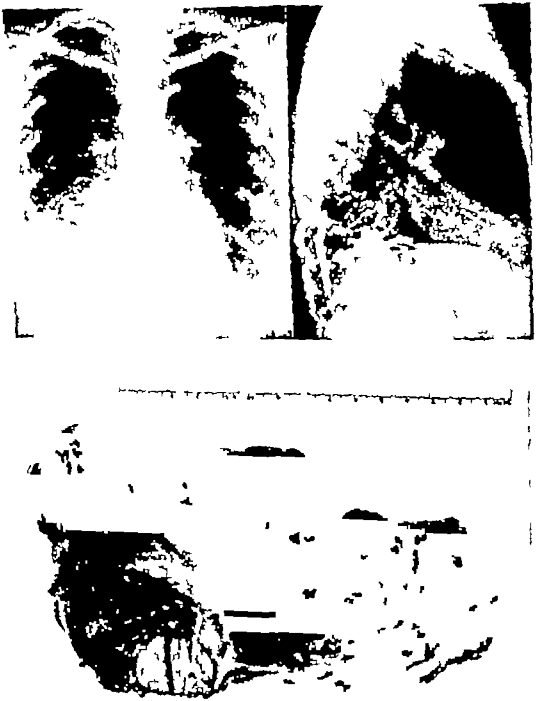

Fig. Roentgen ray appearance in case of right lower lobe bronchiectasis due to obstruction by bronchial adenoma. Note that the middle lobe is perfectly normal as shown in the lateral Roentgenogram. Lobectomy was necessary in this case because a considerable portion of tumor was extra bronchial.

known as "cylindroma" should be differentiated from bronchial adenoma of the ordinary or "carcinoid" type When feasible, resection should probably be resorted to even more promptly in a case of cylindroma than in a case of bronchial adenoma On the other hand, we have had two cases of cylindroma in which surgery has not been done because of the proximity of the tumor to the carina, and these two patients have now been under treatment at rather long intervals for a period of more than five years

Suppurative Diseases In suppurative diseases of the bronchi and lung, bronchoscopy is of great value for diagnosis and treatment, both independently of surgery and in conjunction with it After the usual physical examination and a careful X-ray study, the next step in the diagnostic evaluation in any case of bronchopulmonary suppuration should be bronchoscopy This is important to determine the presence or absence of obstruction and to secure uncontaminated specimens of bronchial secretions for bacteriologic study and particularly for tests of sensitivity to the various antibiotics As for its use in treatment, we may say that in occasional cases bronchoscopic aspiration may contribute very largely to cure In most cases of suppurative disease, however, bronchoscopy is of value chiefly as a pre- and postoperative treatment, and, of course, as a palliative measure in the inoperable cases In the history of the treatment of *pulmonary abscess*, we feel that there have been several periods In what we might call the prebronchoscopic period, this condition was a very grave and even highly fatal one The advent of the bronchoscope, with the aid it afforded to postural drainage, definitely increased the number of patients surviving[4] Surgical drainage had been used, of course, previous to the advent of bronchoscopy and was still being used, however, operative mortality was running high Thus, with the advances in technique of thoracic surgery, bronchoscopic drainage, done early, especially in the so-called "putrid" cases, began to yield a higher percentage of cures, and it came to be recognized that the prolonging of conservative treatment, including bronchoscopic drainage, was unwise in many cases The pendulum, therefore, swung in the direction of more radical surgical treatment With the advent of the "sulfa" drugs and the subsequently even more efficacious antibiotics, the pendulum has swung back again toward more conservative treatment, including bronchoscopy for drainage and the instillation of antibiotics The recognition of the importance of the bronchopulmonary segment for the more accurate localization of disease and more accurate endoscopic diagnosis and treatment has played an important rôle[5,6] (see Fig 3)

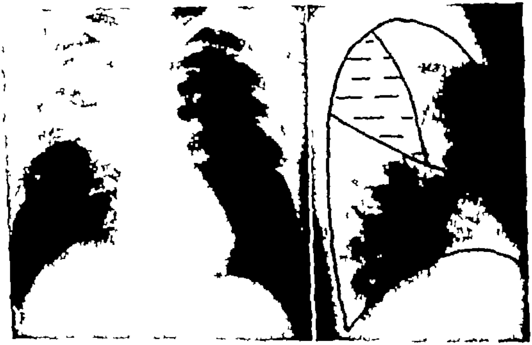

Fig. 3. Pulmonary abscess involving the posterior segment of the right upper lobe. Segmental localization is of fundamental importance in the proper execution *of postural, bronchoscopic, or external surgical drainage.*

In *bronchiectasis*, bronchoscopy, with complementary bronchographic studies, is of great pre- and postoperative value, but there is no doubt that the only effective curative treatment of established bronchiectasis is by resection Bronchiectasis is, as has been well said by Overholt,[7] a 'segmental disease' and obviously, segmental localization is of the greatest importance (see Fig 4) *Before planning the program of surgical treatment in a case of bronchiectasis, it is necessary to map by bronchography all five lobes of the two lungs.* Likewise, the endobronchial appearances should be carefully studied and recorded We believe that bronchoscopic aspiration can be of curative value in the early cases of bronchiectasis, and certainly in the cases of "pseudobronchiectasis," where the dilatations have not yet become irreversible, it is also of value in all cases as a pre- and postoperative measure, and in inoperable cases, it has very considerable palliative value

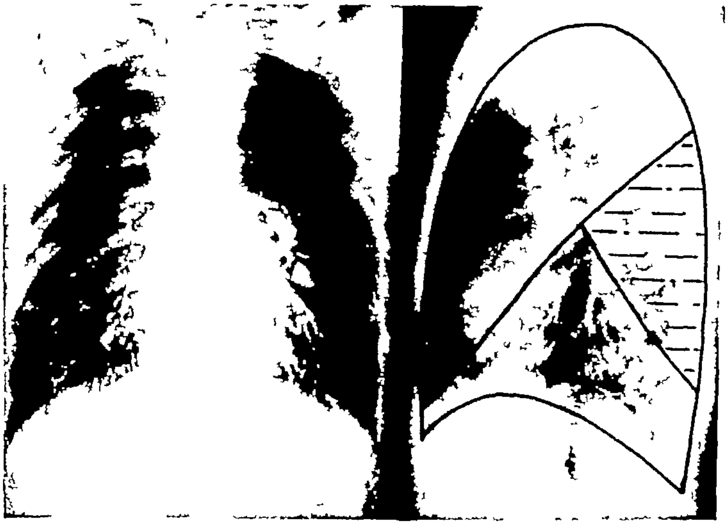

Fig 4 Bronchiectasis localized to superior segment of left lower lobe Segmental resection is indicated

In *empyema*, bronchoscopic observations have shown that bronchial obstruction, of one kind or another, can be an important etiologic and perpetuating factor In our experience, we have seen foreign bodies, both opaque and nonopaque, cicatricial stricture, compression stenosis, endogenous foreign bodies such as broncholiths, among other causes of obstruction (see Fig 5) It should be emphasized, that while empyema can rarely be effectively drained through the bronchus, either spontaneously or by the aid of bronchoscopy, permanent cure will not be obtained by external drainage so long as bronchial obstruction is present It is, therefore, suggested that in every case of empyema the surgeon provide himself with full knowledge of the endobronchial condition, preferably before carrying out surgical drainage

Now, one question which I should like to discuss briefly is the question of *who should do bronchoscopy* Several years ago, I was invited to discuss bronchoscopy before the Section on Oto-Rhino-Laryngology of the British Medical Association,

Fig. 5 Postmortem specimen demonstrating stenosis of main bronchus which was the cause of pulmonary suppuration and *empyema* which caused patient's death. A wheeze had caused physicians to make an erroneous diagnosis of asthma. Diagnostic bronchoscopy would have led the way to curative treatment.

at its meeting in Aberdeen.[*] I gave my views on this subject on that occasion, and I subsequently came to realize that my British colleagues were very much disappointed in the attitude I took because they were very resentful of the inroads being made by the thoracic surgeon into what they considered an important part of the field of the laryngologist I took the view that anyone who wanted to obtain the proper training in the endoscopic procedures had the right to carry them out I stated that the time had come when physicians and thoracic surgeons fully realized the value of peroral endoscopy and yet in some instances they would certainly have difficulty in obtaining prompt and full cooperation from the laryngologist I urged a liberal attitude on this subject, but at the same time insisted that anyone planning to do bronchoscopy should see to it that he had obtained the proper training and practice before examining and treating human patients Ewart Martin[9] was invited a few years later to discuss bronchoscopy at a meeting of the Section on Laryngology, Otology and Rhinology of the American Medical Association at Atlantic City I was a little disappointed that Martin ignored my discussion at Aberdeen, and, of course, one of the reasons probably was the fact that he took a very different view He certainly stated very frankly that he thought bronchoscopy belonged to the laryngologists, and that every effort should be made to retain it as a part of laryngology I still feel that the work must necessarily be done by specialists working in various different fields, and we welcome to our postgraduate courses at Temple University anesthesiologists, thoracic surgeons, pediatricians, internists, phthisiologists and oncologists, as well as the otolaryngologists In his address as President of the American Bronchoesophagological Association a few years ago, Schall[10] stated "There are pessimistic souls and frustrated individuals who bewail this intrusion into what they would have us believe is the exclusive field of the laryngologists Who can resent an internist with sufficient training and skill who desires to complete his examination by his own endoscopic work? Who can censure the thoracic surgeon who wishes to see for himself the problem for which he is going to operate? Surely this specialty is big enough for all who are willing to devote the time and the effort to acquire the skill to perfect themselves in this art Only by teamwork with other branches of the medical sciences will progress be made Bronchoesophagology is not at the crossroads, but is on the high road of scientific progress"

Thorough intensive special training in bronchoscopy and esophagoscopy is necessary for anyone who plans to use these procedures Such training is necessary in order that they may be done *safely* and *efficiently* and *with a minimum of discomfort* I emphasize safety because these procedures can be very dangerous Before the development of refined technique, the mortality was high. In the second place, I stress efficiency because it is desirable that we accomplish the visualization and removal of the foreign body, if the case is one of foreign body If the lesion is a tumor, then it is desirable that we exercise the greatest efficiency in order to obtain confirmation of the diagnosis by biopsy or cytologic study This requires the skillful obtaining of the tissue specimen or the secretions for laboratory examination In the third place, I contend that it is important to see to it that the procedure causes the patient as little discomfort as possible Endoscopic examinations and manipulations can be severe ordeals for both the patient and the endoscopist, but with proper training and experience the strain and discomfort suffered by both is minimized

Before closing, I wish again to call attention to the importance of the modern understanding of applied bronchopulmonary anatomy and particularly the concept of *the broncho pulmonary segment*[5,6] This concept is of vital significance in the diagnosis and treatment of diseases of the bronchi and lungs. It is important in pulmonary abscess and in bronchiectasis, and also in tuberculosis. It is of importance in the early diagnosis of tumors of the bronchi and it is of obvious importance in the localization and extraction of foreign bodies Furthermore, the wide adoption of a common simple nomenclature is essential to the mutual understanding of the bronchoscopist and the thoracic surgeon, as well as, of course, in the understanding between both of these and the radiologist. It is to be hoped that in the near future a universal agreement will be reached on this subject (see Fig 6)

Finally, I wish to urge that bronchoscopy not be considered as competitive with surgery We should avoid the "partisan spirit," and think not of bronchoscopy versus surgery, but of

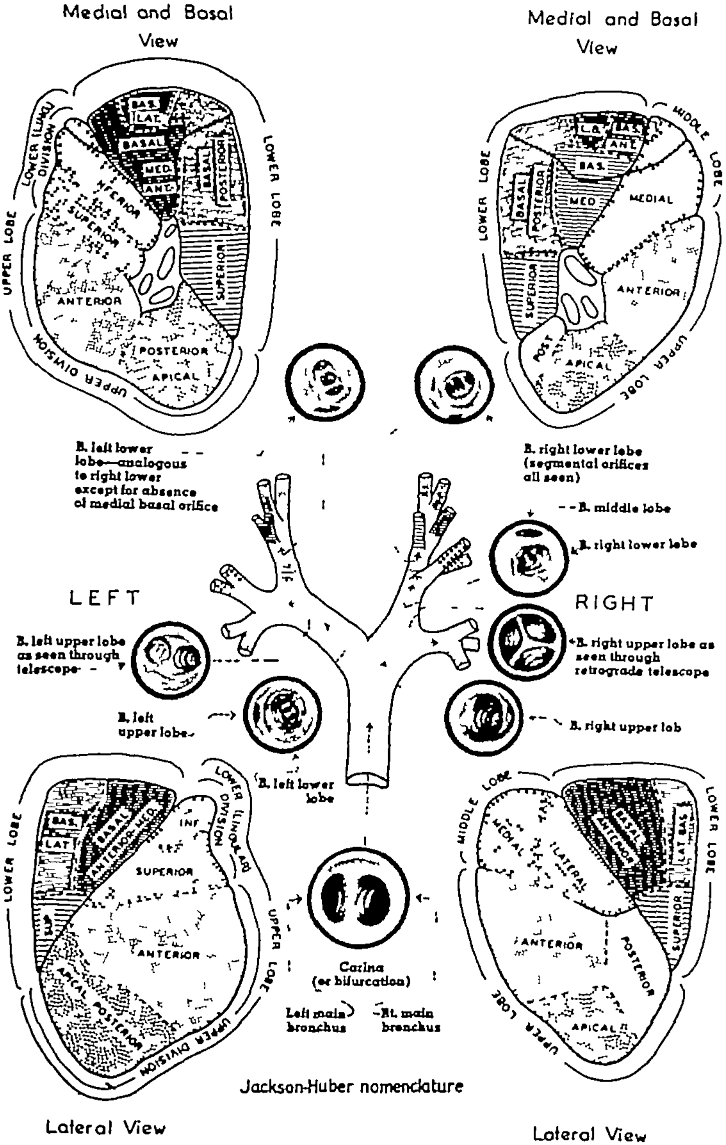

Fig 6 Chart showing anatomy of the bronchopulmonary segments and their corresponding segmental bronchi The endoscopic landmarks of the various segmental bronchial orifices are shown in the circles The inverted position is used in order to present the anatomical parts in the same relation as these parts bear to the bronchoscopist s eye during bronchoscopy (From Jackson and Jackson Bronchoesophagology W B Saunders Co Philadelphia 1950)

bronchoscopy plus surgery versus the disease Let us think of the bronchoscope as a bronchial speculum, as such we must recognize that it is an instrument indispensable in the diagnosis and treatment of bronchial disease, and one of the most important instruments in the hands of the thoracic surgeon whether he chooses to use it himself, or to delegate its use to a bronchoesophagologist or laryngobronchoesophagologist on his staff

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SYMPOSIUM

(c) — THE RELATIONSHIP OF BRONCHOSCOPY TO CHEST SURGERY *†

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The last 25 years have seen a change in the application of bronchoscopy Though the removal of foreign bodies and the aspiration of purulent secretions from the trachea and bronchi are still important, by far the most frequent use of bronchoscopy today is to examine and study carefully the trachea and bronchi to determine pathological lesions in the lower air passages

What has happened and why has this change taken place? The genius of Gustav Killian and his assistants began bronchoscopy, and to Chevalier Jackson, because of his ability, his work and his teachings, is due the great interest in and the development of modern bronchoscopy With the increase in the numbers of doctors, mostly laryngologists who did endoscopy, many cases of bronchiectasis and lung tumors were diagnosed These cases were discussed with those surgeons interested in chest diseases (tuberculosis and empyema) Soon, lobectomies were being done for bronchiectasis and pneumonectomies for lung tumors (Graham, 1933, Rienhoff, 1933) In 1916, Dr L F Barker, a distinguished clinician, wrote of bronchoscopy, "With some practice it is possible to view the bifurcation of the trachea, the entrance into the two chief bronchi, and the subdivision of a main bronchus Only experts can be expected to use the apparatus " This was just one year after Chevalier Jackson had published his enlarged work (1915) on "Peroral Endoscopy and Laryngeal Surgery "

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The association of bronchoscopy to chest surgery, and especially to lung surgery, is extremely close. Chest surgery also includes surgery of the heart, mediastinum, esophagus, and the great vessels, and to this surgery bronchoscopy is not so closely related The association of bronchoscopy to chest surgery may be likened to the association of laryngoscopy and laryngeal surgery Before laryngoscopy, Ehrman found 31 cases in all the literature of laryngeal tumors removed by surgery From 1854 to 1899, after laryngoscopy had been developed by Garcia, F Semon gathered 12,297 cases of laryngeal tumors Greater vision had improved the diagnosis and also the treatment Likewise, the wider use of the bronchoscope and bronchoscopy has improved the diagnosis and treatment of diseases of the lower respiratory tract

Should bronchoscopy be done by the laryngologist or the chest surgeon or by a doctor trained and interested in endoscopy? The answer is obvious If a chest surgeon is interested and trained in bronchoscopy, there is no reason why objections should be raised, nor should objections be raised if an endoscopist, after proper training, should do chest surgery In large clinics, however, the amount of endoscopic work and chest surgery is so great that it is difficult for one service to do both efficiently

Competent endoscopy requires long training, constant practice, and a large quantity of delicate equipment, and for best results, in my opinion, should be under the direction of one who is interested primarily in its use and development.

One use of bronchoscopy is to select cases suitable for chest surgery For those cases requiring surgery it must not only give aid in the diagnosis but also information to the surgeon as to the physical condition of the lower respiratory tract During operations or in the postoperative state, endoscopic therapy can also mean the difference between life and death Bronchoscopy is an adjunct of chest surgery, though it is a complete specialty in itself

Bronchoscopy is just one part of endoscopy, whereas chest surgery serves the whole field (lung, mediastinum, heart, blood vessels and esophagus) Telescopic views of the upper lobe bronchi have enlarged the visual field, and magnification has aided the closer study of pathological lesions

The bronchoscopic removal of tissue for diagnosis and cells for microscopic study can give positive diagnostic answers The endoscopist is a member of a chest team along with the surgeon, roentgenologist, physician and pathologist Each has an important rôle in the diagnostic and therapeutic problem One operation, one X-ray film, one physical examination, one microscopic slide may clear the confusion and the findings of one bronchoscopic examination can be the solution of a most puzzling lung picture

ANATOMICAL CONSIDERATIONS OF DEEP INFECTIONS OF THE NECK.*

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The structures in the neck are few in number and, like the structures in the limb, they *mostly run longitudinally* — from the skull through the neck to the thorax, some reaching even the abdomen. In the midline lie the viscera of the neck — *pharynx* and *esophagus*, larynx and trachea, and the associated thyroid gland On each side of these lies a vagus nerve This vagus or vagrant nerve supplies these viscera, and with the carotid arteries and the internal jugular vein, it occupies a place in the carotid sheath. On each side is the sternomastoid, in front are the depressors *of the hyoid bone*

That these various structures do not rattle about loosely in the neck is due to the fact that they are embedded in a matrix of areolar fascia. Were it not for this fascia, pus resulting *from deep infections would flow freely among the various* structures of the neck much as rising flood water flows freely between the trees of an inundated forest

This leads us to ask ourselves, "what is the nature of this so-called *areolar fascia?*" We would briefly answer, "just as fishes and other objects in the sea are wet all over with water, so in the embryo all the structures in the neck are, as it were wet all over with mesoderm — mesenchyme — in which they developed" As the structures develop they enlarge and expand and the relative amount of mesenchyme may diminish, *e g*, in the case of the parotid and submandibular glands only a thin partition remains to separate them, and it becomes the stylomandibular ligament.

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Areolar Tissue We must be careful, then, to think of fascia not as so many sheets of paper but as partitions or septa in a sponge or in a honeycomb Some partitions may be almost as strong as fine steel, others are as delicate as gossamer

Our problem, then, is largely one of knowing where the fascia is thick and resistant, where gossamer-like and, therefore, negligible clinically

Just as loose areolar tissue is required between the bladder and the rectum to allow each of these hollow organs to expand and contract independently of each other, so areolar tissue is required between the trachea and the esophagus, and a still greater quantity is required between the esophagus (and at a higher level the pharynx) and the prevertebral muscles, in order to allow movements of swallowing and movements of the neck

In the retropharyngeal region there is much loose, froth-like areolar tissue, which is very easily broken down with the finger It extends laterally to the carotid sheath If the peritoneal cavity extended to the neck it would be found here between the viscera and the depressors of the larynx, which indeed represent the rectus abdominis and might well be called the rectus cervicis

Here, then, are three loosely filled spaces, prevertebral, retropharyngeal and pretracheal, which when followed downwards lead to the superior mediastinum

The prevertebral and the retropharyngeal spaces are readily approached from behind the sternocleidomastoid muscle and the carotid sheath, in approaching the pretracheal region and root of the neck I would remind you of an unnamed vein that lies along the anterior border of the sternocleidomastoid muscle, commonly present, sometimes achieving the size of one's finger and, therefore, likely to be mistaken for the internal jugular vein This disconcerting vessel connects the common facial vein to the anterior jugular vein

At the root of the neck, pleura clothes the esophagus (which bulges to the left) on each side and may be wounded

Running from the skull through the neck to the thorax is the carotid sheath This sheath is actually a tunnel in the areolar sponge-work Its condensed wall fits it like a loose garment, and where a branch leaves the artery a branch leaves the canal, too, with the result that there is a loose areolar branching system of tunnels throughout the neck, *e g* , the facial artery, on leaving the external carotid runs in a canal that traverses first the parotid region, the submandibular region and ends in the face

Above the hyoid bone three areolar spaces engage our attention the pterygomaxillary, also called the lateral pharyngeal the parotid and the submandibular

It is important to note that these spaces do not descend below the hyoid bone for no muscle crosses the hyoid bone. Indeed, the simplest means of entering the pharynx, theoretically, is to cut through skin, hyoid bone and mucous membrane, for no muscle crosses the hyoid bone, either on the outside or the inside, so it is a barrier, shall we say between the north and the south. In order to spread to lower levels, pus in either of these regions must either burst onto the surface or pass backwards and descend with the carotid sheath.

The lateral pharyngeal space is the space that may be infected either from the tonsil or by a needle carrying infection when the dentist injects the lingual and inferior dental nerves It is largely filled with fat and crossed obliquely by the medial pterygoid muscle Medially is the superior constrictor, laterally the ramus of the jaw behind the parotid gland, the styloid process and the carotid sheath The fascia in front of the parotid is the strong stylomandibular ligament. The fascia in front of the carotid sheath extends to the side wall of the pharynx and is as strong as fine steel.

This slide shows the tonsil herniated between the fibres of the superior constrictor — the surgeon could hardly be blamed if the space were infected when removing such a tonsil We see the Eustachian tube at the roof of the space and we see where the steel-like stylopharyngeal membrane extends from the styloid process, the lower border of the tympanic plate and the pharynx The carotid artery and the jugular vein are behind

Here we have the lateral pharyngeal space seen from behind The carotid sheath and the steel-like stylopharyngeal ligament have been removed, thereby revealing some of the fat in the space, which extends up to the Eustachian tube

This slide shows where the injecting needle would pierce the buccinator before passing between the ramus of the jaw and the medial pterygoid

To enter the space from the neck it is well to keep below the border of the jaw, lest we encounter facial artery and vein and the nerve to some depressors of the lower lip, so, using Mosher's approach, we must divide some branches of the common facial nerve, raise the submandibular gland, push through the roof of its ballooned-out space and pass upwards close in front of the angle of the jaw towards the tip of the styloid process

The process may be short or long or it may extend down to the lesser horn of the hyoid bone, in which case it is in several pieces articulated together

We then push up, keeping close to the medial side of the medial pterygoid, which on this surface receives many small twigs from the facial artery, and more posteriorly a tortuous internal carotid artery may be applied to it

Our deeper landmarks are the greater horn of the hyoid bone, above which is the posterior belly of the digastric, here crossing the hypoglossal nerve before passing deep to the mylohyoid muscle I think it is evident that an infection round about the lingual nerve can travel downwards into the mouth along the nerve backwards along the duct into the submandibular region Fig 17 showed cross-section of the head just below the level of the mastoid process Fig 18 showed some adenoids, the mouth of the Eustachian tube and the apical part of the lateral pharyngeal recess, the steel-like portion, stylopharyngeal ligament in front of the carotid sheath and the thin gossamer like covering of the parotid gland above the level of the stylo-mandibular ligament, which with a mere covering of fascia projects into the lateral pharyngeal space

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PRACTICAL CONSIDERATIONS IN THE RELATIONSHIP OF SEPTAL PROCEDURES TO RHINOPLASTY *†

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In recent years a great increase in attention to surgery of the anterior segment of the nose to correct defects interfering with nasal function has taken place, stimulating tremendous improvement in our techniques for correcting defects of this region This surgery must necessarily involve the skeletal structures of the external nasal pyramid, of the columella and of the septum as well

Without entering into a controversy regarding which specialty should deal with defects of the nasal pyramid, it can be said unequivocally that no rhinologist can deal adequately with nasal function without availing himself of the surgical principles of rhinoplasty Inevitably, one must quickly add that cosmetic factors, either acknowledged or subconscious, will frequently play a part I have never had a patient complain about the cosmetic improvement which incidentally resulted from the straightening of a deviated nasal pyramid coincident with surgery to correct mechanical obstruction of the nasal airway

Literature on the problems of deformities of the septum, as they affect the nasal airway, appeared around the turn of the century The paper of Freer,[1] read before this Society in June, 1905, at Boston, and Killian's[2] paper, which was published the same year, are landmarks in the history of otorhinolaryngology The awakening interest of rhinologists,

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generally to rhinoplasty, however, stimulated a great deal of thought regarding the relationship of defects of the nasal pyramid and its skeleton to obstruction of the nasal airway Noteworthy are the papers of Fomon and his group,[5] Becker[6] Salinger,[7] Converse[8] and Peer[9]

The first real effort to deal with defects of the caudal end of the septum was made by Metzenbaum[10] in 1929 Since this contribution, an evolution in our concept concerning the role played by the septum in giving support to the nasal structures has taken place This subject is treated in detail elsewhere, but suffice to say whether one believes in the importance of the septum as a support to the external nasal pyramid, will color one's appraisal of the relative merit of various operations proposed to correct various septal deformities

To establish my position, I am convinced that the external nasal skeleton will stand by itself without support of the nasal *septum, unless that nasal skeleton made up of the nasal bony* processes, upper lateral cartilages and lower lateral cartilages are congenitally aberrant or rendered abnormal by factors to be discussed later in this paper

I also believe the collapse of the nasal tip or of the upper cartilaginous part of the external nasal pyramid following corrective surgery of deviations of the nasal septum is due to the internal traction forces of healing of deskeletonized membranes and *not* to lack of support *per se*

Peer in 1937 was one of the first after Metzenbaum to undertake the problem of deviations and deformities of the caudal end of the septum Fomon and his group have arrived at a solution of this problem essentially similar to that of Peer, but for radically different reasons Converse and Becker as well as many others have discussed in detail their techniques for treating various kinds of deformities of the septum when associated with deformities of the nasal pyramid

Due to the number of variations and combinations of deformities that are possible, a general discussion of the whole problem must necessarily underemphasize the practical details of the relationship of those procedures to rhinoplasty The final object of the procedure, the character of the cartilage to be dealt with, the duration of the procedure, the effective duration of the anesthetic, and the proper selection of sequence of multiple procedures are factors of the greatest practical importance in planning one's solution for any given specific case These practical factors will here be enumerated and discussed before consideration is given to how these factors affect the relationship of septal surgery to rhinoplasty Whether treatment of defects of the external pyramid, of the septum and internal structure of the nose, or of both, is to be undertaken must be determined, as the most important consideration here is the operating time required to accomplish the desired result It is axiomatic that to obtain the maximum correction of a deviation in the nasal airway, deviations in the external pyramid of the nose must be eventually corrected along with deviations of the septum found internally Correcting these external deviations is rhinoplasty, and it is inevitable that while the external nose is being replaced in the midline, the patient will be pleased by any supplemental rhinoplastic procedure which will improve the cosmetic defects Generally, therefore, the surgeon is not going to stop when he has the nasal pyramid in the midline and has dealt with the defects which interfere with breathing If the nose is a pugilistic type with a saddle, he is going to build up the depression as well as straighten the pyramid If there is a hump, he will remove it These procedures take time, and the time consumed is the first factor under consideration

DURATION OF PROCEDURE

With adequate and trained nursing help after surgical preparation of the patient, the ordinary rhinoplasty without treatment of septal deflections in most experienced hands requires upwards of one and one-half hours Surgical procedures dealing with deviations of the upper lateral cartilage, alae and columella are integral parts of rhinoplastic procedure which must be dealt with in every rhinoplasty and, therefore, require no additional time If the septum is to be operated upon as well, the additional time required will depend upon the nature of the cartilage to be dealt with as well as the septal defects encountered Firm, smooth cartilage, no matter how badly deviated, may be dissected free of membrane quickly and easily When this kind of cartilage is met, minimum time is required Unfortunately, this situation obtains seldom in the case requiring corrective replacement of the nasal pryamid since a deviating nasal pyramid associated with septal deflections is most often traumatic in origin, and, hence, the cartilage is usually altered in character

Reduplicated and compartmented septal cartilage is most frequently encountered as a result of nasal fracture, the septum most often has been comminuted During the process of healing, fibrous invasions between the perichondria on the two sides of fragments of cartilage are formed, thus compartmentalizing the deviating septal cartilages. Frequently, one fragment overrides another and heals in that position. Thus, reduplicated cartilage is found with two pieces of cartilage lying one beside the other in separate fibrous compartments (see Fig 1)

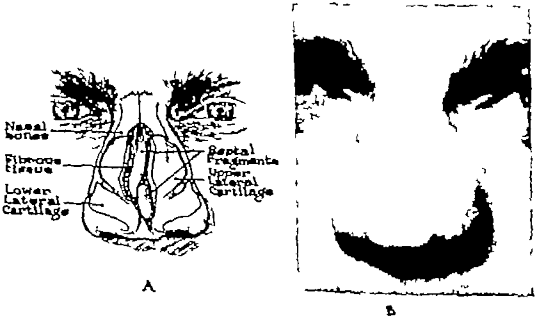

Fig. 1. (A) Schematic drawing and (B) actual photograph of reduplicated, compartmented septal cartilage resulting from old nasal fracture.

Fibrosis of the cartilage may exist as a result of partial organization of septal hematoma or abscess Fibrous tissue will invade the cartilage plate itself rendering the cartilage mushy, inelastic and difficult to separate from its perichondrium This process of healing is observed not only in septal cartilage but may be also seen in the thickened skin of the face and in the mushy, soft, thick cartilage of the upper laterals, alae and the cauliflower ears of the old prize fighter (see Fig 2)

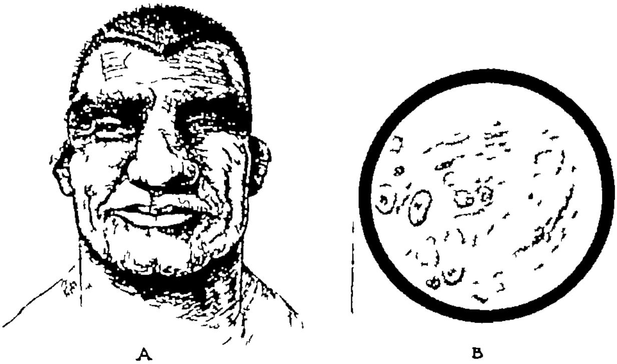

Fig 2 (A) Drawing taken from actual photograph of pugilist a veteran of more than 200 professional prize fights (B) drawing from photomicrograph of upper lateral cartilage taken from the same patient showing fibrous invasion of cartilage due to organization of hematoma

A thickened septum sometimes massive in width may exist from fibrosis of septal cartilages due to repeated trauma (see Fig 3) Subperichondrial hematoma will often form in the

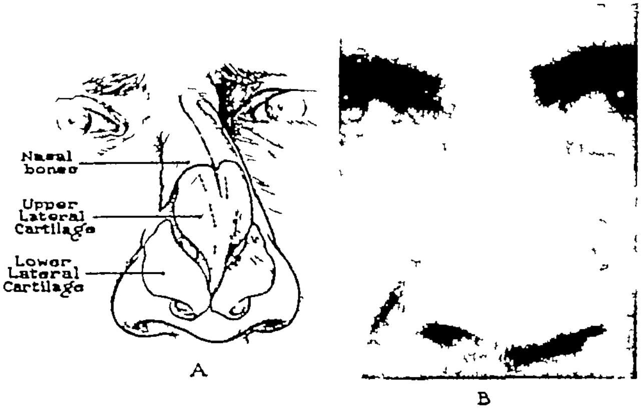

Fig 3 (A) Schematic drawing and (B) actual photograph showing tremendous deviation of bony component of nose due to trauma

angle where the cartilage of the septum joins the upper lateral cartilages. If this hematoma is organized the septum may be a centimeter or more in width at this point, producing a spreading of the upper cartilaginous component of the nose (see Fig 4)

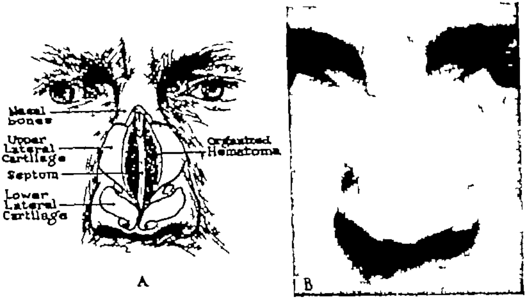

Fig 4 (A) Schematic drawing and (B) actual photograph of the spreading effect produced by organized hematoma in the angle between the cartilage of the septum and the upper lateral cartilages.

Congenitally small quadrilateral cartilage may contribute to the problems of the septal procedure One may repeatedly observe that the individuals with great deviation of the external nasal pryramid, whether due to trauma or to growth factors, have a congenitally small quadrilateral cartilage, therefore, the septum is rigid, being made up primarily of bone which is less able to absorb a blow without fracture and deviation Finally, the membrane over a sharp deviation is generally atrophic and easily shredded, a condition which may considerably complicate any septal procedure (see Fig 5)

HOW DO THESE FACTORS AFFECT OPERATING TIME?

Any one or any combination of these situations will enormously increase the operating time required to deal with the septum The preoperative diagnosis of the existence of these conditions will help in planning the procedure, but complicated submucous elevation under practical conditions will frequently produce shredded or perforated membranes, increasing the already considerable number of incisions which will be required for the rhinoplasty

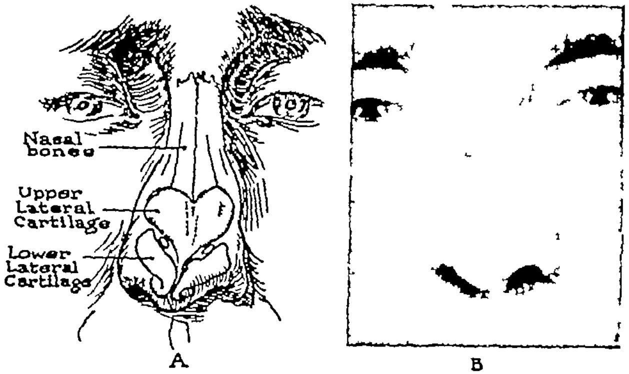

Fig 5 (A) Schematic drawing and (B) actual photograph showing the deviation of the lower components of the nose due to congenitally small cartilage of the septum and upper lateral cartilages

THE ANESTHETIC

The largest percentage of septal or rhinoplastic procedures are done under local anesthesia with procaine and cocaine block Properly done, the anesthesia is excellent With adequate preoperative sedation even the most apprehensive patient is at ease

In addition to its excellence, this type of anesthesia carries the least danger, the greatest shrinkage of intranasal mucosa for visibility, and the greatest local vasoconstriction Bleeding is, therefore, minimized, a practical consideration of great importance in the ease with which this work is done, as well as in the final result Operative oozing wastes a great deal of time devoted to sponging, postoperative oozing and edema separates loosely apposed parts which are meant to heal together It may be parenthetically added here that procaine solutions routinely supplied in hospital operating rooms vary tremendously in vasoconstrictive properties The addition of epinephrine is not the only factor involved

Following infiltration and cocaine block, the anesthesia lasts well for a period of about two hours Then pain sensitivity and worse, a secondary vasodilatation with oozing increased by manipulation and edema of the intranasal membrane supervene Reintroduction of anesthesia, whether by infiltration or intranasal nerve block, is grossly unsatisfactory The anesthesia is imperfect and the vasodilatation and oozing are uncontrolled. In addition even in the most stoic patient, the preoperative sedation has worn off and supplemental drugs must be given

Procedures which extend beyond the duration time and vasoconstriction time of the local anesthesia become increasingly unpleasant for the surgeon as well as for the patient Blood appears in profusion from the slightest incision, obscuring the field, the patient frequently has become restless beyond any sedation short of general anesthesia Even with the greatest care, he has not been prevented from swallowing some blood with its attendant nausea and vomiting, therefore, duration of the local anesthesia of about two hours limits the time which may be used, unless the surgical procedure is so planned that the administration of the infiltration anesthesia is delayed until after the septal procedure

CONCEPT FOR PROCEDURE.

In approaching any problem of septal deviation, we consider the portion of the septum ordinarily dealt with in the Killian operation as Part II, which excludes the ventral buttress and the caudal margin of the septum. Our Part I in this discussion is that part which remains untouched in any Killian procedure Its treatment is to be considered as part of the rhinoplastic procedure (see Fig 6)

This concept is at variance with that of Fomon *et al* who arbitrarily divide the nasal septum into an anterior and posterior compartment by an imaginary line drawn from the frontal spine to the nasal spine A portion of the septum lying in their anterior compartment is ordinarily treated by the Killian procedure, the remaining portion (our Part I) is intimately exposed during rhinoplasty and may be best dealt with after the nasal skeleton is exposed by the routine incisions of the rhinoplasty

Fomon *et al* advocate operation on the septum through an incision made below the free caudal margin of the quadrilateral cartilage This procedure, while it adequately exposes the caudal free margin for treatment, makes deviations in the posterior part of the nose more difficult to visualize The division of the septum into anterior and posterior compartments tends to underemphasize the importance of deviations in the posterior portion of the nasal fossa

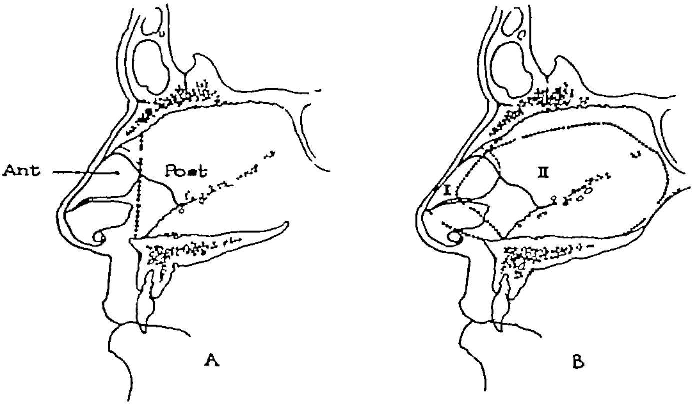

Fig 6 (A) Procedural concept of the septum after Fomon et al showing its division into anterior and posterior components (B) Division of septum into Parts I and II as dealt with in the Killian procedure Part II is dealt with in all Killian submucous resections Correction of Part I deformities is dealt with in the subsequent rhinoplastic procedures

In planning the procedure, details of operative treatment of Part I abnormalities of the septum (see figure) are discussed by Fomon *et al*, Converse and Becker, and others These discussions, however, tend to underemphasize first, treatment of deformities of the posterior part of the septum, and second, the practical technical difficulties discussed in this paper which greatly influence operative time Fair assessment of the situation before the operation may frequently but not always be made

The pugilist nose is a particular problem — thick eyelids and maxillary skin, the typical flat, deviated nasal pyramid, a soft, easily depressible nasal tip, a thick, severely deviated nasal septum, all portend great technical difficulty with submucous elevations

A firm septal cartilage, a firm nasal tip, and a generally thin septum, although badly deviated, usually indicate an easily accomplished submucous elevation of membranes

INDICATIONS FOR A TWO-STAGE PROCEDURE

In any case requiring treatment of the septum, as well as the external nasal pyramid, the question arises whether the surgery may best be accomplished in one stage While in the great majority of instances this situation exists, a two stage operation, on occasion may best be done. First, a badly deviated caudal end of the septum, and second, the reduplicated compartmentalized or fibrous septum combined with external deformity of the nose requiring correction should be planned in two stages In the first stage, a typical Killian submucous resection may be done in which care and adequate time may be devoted to elevation of the membranes

In approximately one month, the rhinoplastic procedure with routine incisions, sharp dissection, and transfixion of the nose may be undertaken without undue increase in operating time Defects of the Part I portion of the septum (caudal and ventral portions left by the previous Killian procedure), defects of the upper lateral cartilages and alae may be dealt with Thus a two-stage operation is done without difficulty

ONE-STAGE OPERATION

The one-stage operation may at most times be used A Killian type of submucous resection is first accomplished, followed by the rhinoplasty, during which time the portions of the septum left by the Killian procedure are dealt with The patient is placed on the regular operating table in a supine position. Only that anesthesia required for the septum is administered, and the patient is prepared and draped as for rhinoplasty A typical Killian submucous resection is done. If turbinate plastics or other intranasal procedure is required, it is also done Then, without changing drapes, the procaine infiltration block for the rhinoplasty is now administered and the rhinoplasty procedure is begun (see Fig 7)

If the surgeon encounters unexpected difficulty in the Killian procedure, or if the membranes are unduly shredded, he may stop at the end of the Killian procedure, the rhinoplasty being done at a future time In any case, the infiltration anesthesia for the rhinoplasty is saved for the time it will be needed, thus greatly extending the available operating time

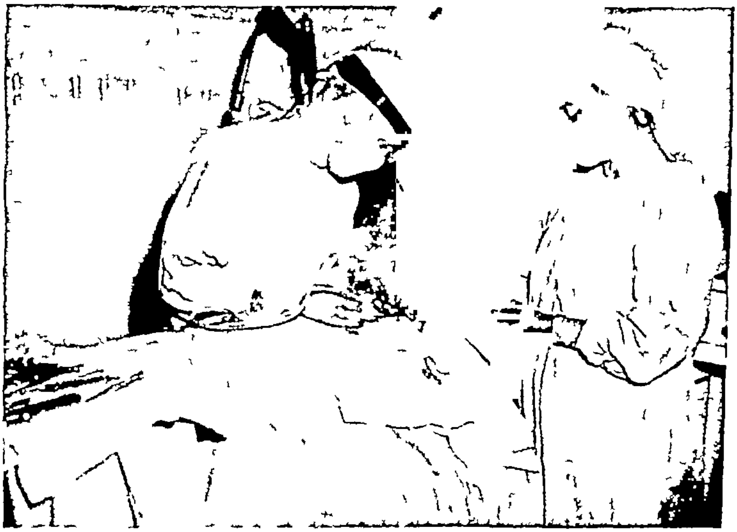

Fig 7 Photograph showing the operating position for Killian submucous resection which precedes rhinoplasty in one stage

Another great advantage of this procedure is that the Killian operation is the best source of stiff, autogenous cartilage for implant in any rhinoplasty in which cartilage remnants of sufficient size or quality will not be produced during the routine operation If a quick Killian type incision and removal of as much quadrilateral septal cartilage as will be required is done before the rhinoplasty is begun, the best implant material for columellar or lobular defects may be obtained, providing, of course, that previous submucous resection has not been done There is no argument that autogenous cartilage is far superior to preserved cartilage whenever it is obtainable

SUMMARY

When correction of septal deformities is to be combined with surgery of the external nasal pyramid, various practical factors limit the amount of surgery that can be done at one stage. These are the duration and vasoconstrictive time of the local anesthetic, as well as *alterations of the nasal* and septal cartilages due to the healing processes following trauma Reduplicated, compartmentalized, fibrotic or thickened cartilages frequently complicate the ease with which the septal procedures are accomplished.

In order to extend the anesthesia time, infiltration block of the nose is withheld until after a classical Killian type sub mucous resection is done. Any remaining defects of the septum left uncorrected (in the ventral buttress and caudal end of the septum) are treated after routine exposure by the *classical incisions of the rhinoplasty*

The indications for a one-stage and two-stage operation are discussed

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RECENT WORK IN VIRUS DISEASES [*][†]

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Toronto, Canada.

Although the field of virus infections may appear to be far removed from the subject of otolaryngology, a number of recent developments have occurred, which I trust may be of some interest to many of you.

Viruses are now considered to be a group of infective agents which have become adapted to intracellular parasitism through a lengthy process of retrograde evolution. With increasing adaptation to the invaded host cell, there has been corresponding dependence upon the host cell for essential growth substance with simultaneous loss of function and progressive decrease in size.

Thus the largest viruses such as vaccinia and psittacosis presumably retain some slight degree of independent metabolic activity, whereas the smallest ones such as that of poliomyelitis seem to be completely dependent upon the cell for continued multiplication. The relationship between virus and host cell is somewhat analogous to what I visualize may be the ultimate outcome of man's continued survival in the environment of a highly socialized state. Thus as the latter provides man with ever increasing amounts of the various necessities for life, man in turn will suffer progressive loss of natural functions through disuse atrophy of various organs.

Finally I perceive that he may degenerate into a virus like parasite upon the nutrient state and, like the viruses, will retain only the power of reproduction by special permission.

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The intimate relationship between virus and host cell also brings with it more practical problems of immediate concern to surgical and medical practice

We still lack effective and potent antiviral substances for therapeutic use Little is known, as to in which class or category of chemical compound, the search for antiviral agents should be directed The close relationship between viruses and host cell also restricts greatly the range of available compounds from which potential antiviral agents may be selected for laboratory tests

Many thousands of substances have already been examined for antiviral activity, but the results have generally been disappointing, so, for the present, the problem appears to be insoluble

Virus affections of the upper and lower respiratory passages probably claim first place of importance in view of their frequency and high incidence in the conduct of medical practice

Over the past decade considerable progress has been accomplished in the better understanding of this group This has resulted in part from our ability to eliminate primary bacterial infection with the aid of antibiotics and, in part, from the development of newer methods for the cultural isolation and serological identification of viral agents The control of secondary pyogenic complications may also have changed the picture Thus, it is noteworthy that since the inception of antibacterial remedies, despite conditions caused by late war and overcrowding in large cities, there has been no recurrence of pandemic influenza comparable in scale or severity to that which scourged Europe in the years 1914-1919

Whether or not influenza of the latter variety would ever return, it is impossible to predict, but within the last few consecutive years annual outbreaks of epidemic influenza in Europe, Great Britain, Canada and the U S A have been shown to be caused by influenza virus of the A-prime type By the use of egg cultivation techniques and serological methods it is now possible to identify speedily the epidemic influenza virus, likewise, the ability of influenza virus to grow in the embryonated egg has opened the path for trial of prophylactic immunization.

Work continues on the common cold, relatively little has been contributed since the condition was originally proved to be a virus disease by Dochez *et al* (1930), who successfully infected man and chimpanzee with filtered material No laboratory animal has as yet been found to be susceptible to infection with the common cold virus

A few workers, however, have been able to pass the agent in chick embryo material tissue cultures, *e g*, Dochez *et al.* (1936), Powell and Clowes (1931) The virus has also been propagated in the allantoic sac of egg embryos by Pollard and Caplovitz (1948) and Topping and Atlas (1947) Unfortunately, the common cold virus grows with difficulty only in the egg embryo and it has not been possible to put these findings to practical use. More recently some disappointing human transmission experiments have been reported from England by Andrewes *et al* (1951) The reseaches of the latter have contributed nothing new, but the data does reveal the erratic results which may be expected when strains of virus isolated in Great Britain are tested for pathogenicity in human volunteers obtained from the same country Andrewes' efforts also reveal the need for better design and more statistical direction in the planning of such experiments Simultaneously with the studies already mentioned on influenza and the common cold Dingle and co-workers of the U S Commission on Respiratory Diseases have strived to unravel the clinical tangle of the numerous common but ill-defined varieties of malady prone to affect the respiratory tract.

Thus on the basis of clinical symptomatology epidemiological characteristics, and the outcome of infection immunity experiments on human volunteers, Dingle has postulated the existence of a spectrum of common respiratory diseases These comprise a series of closely related clinical entities ranging from afebrile common cold to febrile atypical pneumonia Intermediate between which lie such states as nasopharyngitis, laryngitis exudative tonsillitis and pharyngitis, acute respiratory disease or grip, and bronchitis The separation and identification of these diseases presents a problem of exceptional difficulty since the clinical features of one disease may not infrequently merge into those of another In the absence of susceptible animals and better tools for the recognition of specific viral infections, progress must necessarily be slow

There has been revival of interest in the condition of herpangina described by Zahorsky in 1920, following the studies of Heubner *et al* (1951) The latter investigated an outbreak of this condition in Maryland during the Summer of 1950, characterized by illness of short duration, accompanied by sore throat, headache, abdominal pain and large faucial ulcers

From such cases, Heubner *et al* (1951) successfully isolated Coxsackie viruses of the Group A, Dalldorf Type 2 and High Point Texas Type From their studies, Huebner concludes that herpangina constitutes the main clinical manifestation of human infection with the Coxsackie Group A viruses I would suggest that the study of herpangina merits your careful attention, and in every suspected case, an effort should be made to isolate Coxsackie virus by the customary laboratory procedures

Procedures said to cause predisposition to poliomyelitis infection have attracted wide attention over the past three years According to Australian sources, McCloskey (1950) observed that of 340 cases of poliomyelitis observed by him, 31 cases had received an injection of diphtheria toxoid or pertusis vaccine, alone or in combination, within three months of the onset of their symptoms, furthermore, in 17 of them under three years of age, who had been inoculated 35 days previously, the severity of paralysis was much greater in the affected limb than in a comparable group of inoculated children In a further series of 410 patients studied by Hill and Knowelden (1950), in England, it was also shown that in recently inoculated children the limb of injection (arm or leg) was a site of paralysis much more frequently than was the case with children not recently inoculated. These effects appear to be confined to injections given within about a month of the onset of poliomyelitis, and after that interval from inoculation has elapsed no risk need be envisaged

It would thus appear that the act of inoculating children already presumably suffering from the subclinical and non-paralytic disease may have induced the same to develop paralysis.

Hill and Knowelden (1950) point out, however, that it is difficult to ascertain the relative risks of contracting poliomyelitis among two groups of children, the one inoculated and the other not, without recourse to laborious statistical investigation

The latter aspect of the problem has received the attention of Korns *et al* (1952), in New York State, who determined that the risk of developing poliomyelitis among a normal assembly of children studied was approximately one in 4,000, as against one in 2,000 for a comparable group of children who had received inoculation of different substances for a variety of reasons, including minor surgical procedures, tissue infiltration *for* local anesthesia and injection *of* antibiotics. So slight is this difference that, in the words of Korns and co-workers in *pointing to a doubling of the poliomyelitis* attack rate during the month following an injection, we could be accused *merely of doubling the weight of a feather*

The findings of the U S Public Health Service (see *Jour A M A*, 149 170, 1952) have concluded with the statement that there is no definite evidence that an increase in the number of cases of poliomyelitis has occurred as a result of injections of vaccine, drugs or other medicinal agents There is evidence that injections for the prevention of diphtheria, whooping cough and possibly tetanus when given during an epidemic of poliomyelitis may on rare occasions localize the paralysis in the inoculated arm or leg Also of special interest is the statement that 'poliomyelitis is at all times so rare in infants under six months of age and the danger from other infectious diseases, particularly whooping cough, is so great that it is advisable to continue the immunization procedures for this age group even during a poliomyeitis epidemic, however, in view of the slight risks entailed, it has been recommended by Greenberg *et al* (1952) that routine immunizations may well be suspended in older children, during the poliomyelitis season and in epidemic years, the suspension might be extended to infants between six months and one year of age Therapeutic and immediate prophylactic injections should not be discontinued at any time Although no specific recommendations have been proposed in regard to the risk attending tonsillectomy, it is probable that the same general principle may well be observed

Turning to recent developments in the field of comparative medicine, I should like to refer to a disease of unknown etiology, and considered by some to be if viral origin, namely, atrophic rhinitis of swine The disease has also been termed dystrophic rhinitis, rhinitis atropica deformans, sniffles, bull nose and sneezing disease of swine It is prevalent over a wide area of the North American continent, and numerous outbreaks have been reported from Alberta, Ontario and Indiana State, where its presence constitutes a serious problem to the hog raising industry

In young suckling pigs the condition commences with sneezing, mucoid nasal discharge and epistaxis Inflammation of the Schneiderian membrane occurs, and the pig persistently rubs his snout into the ground With the progress of growth the animal develops deformity of the nose which may be deflected from the median line to either side or upwards Distortion of the nose causes interference with mastication due to failure of the upper and lower jaws to engage properly Interference with feeding in turn leads to retardation of growth and, whereas the best Wiltshire sides of bacon are produced from pigs of 200 pounds weight at an age of four months, pigs infected with rhinitis take 10 months or more to attain a similar weight of 200 pounds

The essential pathological lesions of the disease are destruction of the nasal turbinate bones and erosion of the bony palate. Little else is known of the sequence of events, or the mechanism whereby the distortion is produced, or the nature of the infecting agent. Experimental work suggests that the condition can be *transmitted from an infected* sow to her *litter and that the incubation* period is about 30 days [see Quin (1951) and Doyle (1951)]

Another possible virus disease affecting the upper respiratory passages of animals is the condition known as infectious sinusitis or swell head of turkeys

Inflammation of the living membrane of the infraorbital sinuses is produced with attendant accumulation of serogelatinous exudate and distension of the sinuses Circumorbital edema swelling of the neck and obstruction to breathing from closure of the palative opening may cause death of the turkey Recent work suggests that the causal agent may be cultivated in the embryonated egg and the disease reproduced with infected material There is some doubt whether the causal agent may be classified as a virus or as a minute rickettsia like organism [see Jerstad *et al* (1950) and Grumbles and Boney (1951)]

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FIFTIETH CONGRES FRANCAIS d'OTO-RHINO-LARYNGOLOGIE

The Fiftieth Congres Francais d'Oto-Rhino-Laryngologie will be held in Paris in the Grand Amphithéâtre de la Maison de la Chimie, 28 rue Saint Dominique, Oct 13-16, 1952, under the presidency of Mr le Prof Portmann, of Bordeaux, and Honorary President André Marie, Ministre de l'Education Nationale For further information, write to Dr H Flurin, Secretary-General, 19 Avenue MacMahon, Paris 17^{e}, France

SOCIALIZED MEDICINE IN ENGLAND[*]

R SCOTT STEVENSON, M D , F R C S (by invitation),
London, England.

I feel greatly honored to have been invited to be the "guest speaker" of the American Laryngological, Rhinological and Otological Society and your President has asked me to address you on the subject of "Socialized Medicine in England " What I shall endeavor to do today is to give you the facts about the situation in which we find ourselves, describe how it came about, and suggest how perhaps it may be avoided elsewhere

We, in Britain, were by no means the first European country to experience the system that has been termed "socialized medicine." It was Bismarck, the Iron Chancellor, who invented state insurance against sickness, and he did it as a bulwark against Socialism. In 1881, he first introduced a measure providing for compulsory sickness insurance, which was subjected to much criticism, but was eventually carried—against the Socialists and the Radicals—in 1883 Here are the words of Bismarck (May 9, 1884) "Give the working man the right to work as long as he is healthy, assure him care when he is sick, assure him maintenance when he is old If you do that and do not fear the sacrifice, or cry out at State Socialism, then I believe that the gentlemen of the Social-Democratic Party will sound their bird calls in vain " The Danish sickness insurance was instituted in 1892 as a voluntary plan under the control of the medical profession, and within 20 years 70 per cent of the population came under the system Other countries followed Germany and Denmark and today most European countries have some form of State medical service

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In Britain, modern health legislation dates from the Health Acts of 1848 and 1875 in the reign of Queen Victoria Much progress was made in the amelioration of social conditions during the last two decades of the nineteenth century, but this was due to the efforts of private individuals, not of Parliament The historic Liberal Party, after many years in the wilderness, came into power with a great majority in 1906 and its members had an urge to improve everything and everybody The Report of the Royal Commission on the Poor Law in 1909 showed that the medical care of the population was inadequate and that much poverty was due to ill-health Mr Lloyd George visited Germany in 1907 and came home much impressed by the German system of State sickness insurance He introduced his National Insurance Bill in 1911, intending to carry out the administration of the scheme through the Friendly Societies and to place the doctors under their control, but the doctors in the British Medical Association put up such a determined opposition to this that special "Insurance Committees" were formed to deal with medical administration, and upon them the doctors had due representation This Insurance Scheme paid for partly by weekly contributions and from the State, covered only workers and not workmen's wives and children, so that more than half the population in the lower income groups were not insured, but from the doctor's point of view did at least stop the ignominious canvassing by doctors of Friendly Society or Club officials for medical appointments at paltry fees, for the sake of the introduction to family practice, and the new Act gave financial security to doctors in industrial districts such as they had never known before In spite of criticisms, it continued on the same lines up to the outbreak of World War II

The outbreak of war in 1939 helped to integrate the working of the voluntary and the "local authority" or municipal hospitals The Ministry of Health had made a survey of hospital accommodation throughout England at the time of the Munich crisis, and an Emergency Medical Service was organized by the Ministry primarily to deal with air-raid casualties, 290,000 beds being provided chiefly in municipal hospitals, fever hospitals and mental hospitals, and only 40,000 of the beds in new hospitals, the staffs being taken from the honorary and resident staffs of the voluntary hospitals

A rather naive letter was published in December, 1939, in the supplement of the *British Medical Journal,* ii 231, 1939, signed by the three Presidents of the Royal Colleges of Physicians, Surgeons and Obstetricians, and read as follows "There is a suspicion amongst some doctors that the Ministry of Health may be proposing to use the E M S as the thin edge of the wedge for a postwar State Medical Service We can assure such, on the highest authority, that nothing is further from the Ministry's intention and that all such fears are groundless It may well be, of course, that after the war economic conditions may make necessary some form of assistance to the voluntary hospitals, by grants-in aid or otherwise but that the voluntary system will continue there is no reason to doubt"

The three Presidents innocently assumed that the same Minister of Health and, indeed, the same Government, would be in office when the war was over and forgot that the promise of a Minister is not necessarily binding upon his successor In actual fact the Emergency Medical Service did serve as the prototype of the National Health Service in existence today The urge towards a State Medical Service undoubtedly came from the medical permanent civil servants at the Ministry of Health, all of whom had been local authority public health officials and were a little conscious of their own honesty, altruism and rectitude. In their eyes — to modify the words of Lord Horder — the full time salaried doctor worked for God and the private doctor for Mammon

During the war years the "planners" moved slowly In May, 1940, the then Minister of Health (Mr Walter Elliot), in answer to a question in Parliament, said that he did not think the present time opportune for the consideration of a State Medical Service. In January, 1941 the British Medical Association set up a Medical Planning Commission with the cooperation of the Royal Colleges and other representative medical bodies, its terms of reference being "to study wartime developments and their effects on the country's medical services, both present and future"

The whole atmosphere was changed by the publication of the Beveridge Plan in December, 1942 Sir William Beveridge (as he was then) acted as chairman of an interdepartmental committee "set up to survey the whole field of existing national schemes of social insurance and allied services, including workmen's compensation," and the famous "Report on Social Insurance and Allied Services" was signed by him alone The ideal plan, in his view, for a health service was one providing full preventive and curative treatment of every kind for every citizen without exceptions, without income limit, and without an economic barrier at any point to delay recourse to it The report contained the cool remark "The possible scope of private general practice will be so restricted that it may not appear worthwhile to preserve it"

It must be remembered that this happened during a critical period of the last war We in Britain — 50 millions of us, on an island smaller than the states of New York and Pennsylvania put together — were experiencing the instincts of the herd, living together as one people, rich and poor, employers and work-people, soldiers and civilians, in air-raid shelters and in bombed houses, in a way that we had never done before Do not forget that the very first action of Mr Churchill's Coalition Government, on May 22, 1940, was to pass the Emergency Powers Act, through all its stages, in both Houses of Parliament, in one day By this Act the Government was given complete control over persons and property — not just some persons in some particular class of the community, but all persons, men or women, and control did not end with industrial business but was extended to finance and banks, though in actual fact the Government never did interfere with property as such, but it was in this sort of atmosphere and in such conditions that the Beveridge Report appeared, and it swayed the entire nation — even a Representative Meeting of the British Medical Association accepted it with enthusiasm and promised that the medical profession would do its part.

In 1943 the Coalition Minister of Health, the Liberal National, Mr Ernest Brown, put forward proposals for a comprehensive medical service based on the employment of doctors as salaried officers, mainly full-time, by a new type of local authority The B.M.A. thereupon met the Minister and made it very plain to him that his proposals were contrary to the public interest and unacceptable to the great majority of the medical profession. The Minister agreed to regard his proposals as 'in the discard," and shortly afterwards was transferred to another department.

The next scheme got as far as a Parliamentary 'White Paper" in charge of Mr Willink, the Conservative successor to Mr Brown as Minister of Health in the Coalition and one of his suggestions was to place all the hospitals — voluntary (including teaching) and municipal, in the different parts of the country under the control of enlarged local authorities With the dissolution of Parliament and the result of the General Election of 1945, Mr Willink's affable but inconclusive discussions naturally came to nothing

Mr Aneurin Bevan bcame Minister of Health in the new Socialist Government and at once introduced his National Health Service Bill It was opposed by the British Medical Association but the leadership of the Associaton was divided, and its thinking was muddled. The British Medical Association after some discussion accepted that the whole of the population — and not 90 or 95 per cent, as has been argued — should come into the scheme and chose to fight mainly on the retention of the buying and selling of the goodwill of medical practices — although Mr Willink and the Conservative Party (as well as Mr Bevan and the Socialists) had already pronounced against this Then Mr Bevan persuaded his Government to set aside a fund of £66 000,000 (about $200 000,000)* as compensation for the existing medical practices —

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* I have translated pounds into dollars at about their real value not the exchange value of 2.80 dollars to the pound.

providing the doctors came into the scheme on the "appointed day" (July 5, 1948), on which the old National Insurance Scheme would end The general practitioners were to work under Local Executive Councils in the different areas — not directly under the Ministry of Health, managing thus to avoid becoming "civil servants," which was universally unpopular

The whole structure of general practice was to be based upon the provision of some 2,000 health centers The idea of health centers came from Lord Dawson's report in 1920, and was elaborated in the British Medical Association Medical Planning Commission's "draft interim report" of 1942, which was mainly the work of Prof Picken, of Cardiff, and Dr Charles Hill, both of them highly intelligent doctors but former public health officials and inescapably imbued with the health official's outlook The doctors, to my mind, rather rashly accepted this suggestion, because they thought it would take their patients away from their homes, free their wives from duties connected with their practices (85 per cent of doctors' wives, it has been calculated, have such duties), provide them with secretarial and technical help, provide a rota of colleagues for off-duty periods, and possibly provide X-ray and laboratory facilities But "health centers" have proved a pipe-dream, mainly due to building and financial restrictions One pilot center is being built in London, at an estimated cost of £186,000 (call it half-a-million dollars), so one can only guess when a second one will be built

Mr Aneurin Bevan was determined somehow or other to get his scheme going, even at the cost of throwing overboard a good many Socialist principles and in the teeth of many members of his own party In contrast to the studied discourtesy with which he met the representatives of the general practitioners, he was always most polite to the representatives of the specialists The Socialists, and particularly those who had had experience of local government hospitals and the small but extremely vocal Socialist Medical Association, were wedded to the idea of full-time specialists in hospitals Mr Bevan knew that there was no hope of achieving this and quite cynically threw this Socialist principle overboard—"You do not pick the fruit until it is ripe," he said He invited Lord Webb-Johnson, the President of the Royal College of Surgeons to state what the consulting surgeons wanted, if they were going to take part in the State Scheme Part-time appointments with continuance of private practice autonomy for the teaching hospitals and no sequestration of their endowment funds and the continuance of the use of private beds in hospital for fee-paying patients were the terms that Lord Webb-Johnson demanded — looking at things as indeed was probably his duty entirely from the viewpoint of his colleagues, the senior surgeons on the staffs of the teaching hospitals You can have all of these,' answered Mr Bevan but I shall have to put a ceiling of charges for private patients in hospital" 'But many of us get patients from abroad, retorted Lord Webb-Johnson, "I'm a dollar-earner Why should I put a fixed ceiling to such patients?' All right said Mr Bevan 'then we'll allow 15 per cent of the private beds to have no ceiling charges" Mr Bevan himself once told me that he asked Lord Webb-Johnson if there was anything else he wanted for his consultants and there was nothing he could think of—though he might well have remembered that there were hundreds of surgeons and other specialists besides those on the staffs of the London teaching hospitals. One thing he might have asked for but did not, was the statutory recognition of medical committees in hospitals medical staff committees do, indeed, exist but there is no statutory provision for them and their function is entirely advisory — many hospital management committees pay no attention whatever to the advice they give and they might as well never meet.

Mr Bevan's National Health Service Act was passed in 1946 but was not to come into force until July 5 1948 Among the doctors feeling still ran high, after the Act had been passed against taking part in the Service and this feeling was not assauged by the Minister's rather truculent attitude He had had a good deal of success in his attempt to split the medical profession in two and the three Presidents of the Royal Colleges — one of whom was actually Vice-

Chairman of the British Medical Association Negotiating Committee—took it upon themselves to address a friendly letter to the Minister, asking for the elucidation of some minor points, which elicited a polite reply from him, but undoubtedly helped to widen the split with the general practitioners An important plebiscite of the doctors was held in February, 1948, when 38,534 doctors (or 90 per cent of those voting) voted against taking service under the Act, and only 3,471 voted for taking service under the Act While the plebiscite was being held, Mr Bevan tried to intimidate the doctors by making a violent attack on them in the House of Commons, using such phrases as "the small body of raucous-voiced people who were alleged to represent the medical profession as a whole" "a squalid political conspiracy" "The Government took serious exception to organized sabotage of an Act of Parliament"

Then came the anticlimax The leaders of the British Medical Association had achieved a great victory, but did not know what to do with it A "fighting fund" was started, but proved disappointing, for only some 6,000 doctors contributed to it—I, myself, was not one of them I offered to contribute if someone would kindly tell me what the British Medical Association's policy was to be, but nobody could Then information began to dribble in from the branches and "divisions" of the British Medical Association up and down the country, the secretaries were not quite sure that all their members were solid behind them What was going to happen when the National Insurance "panel" income ended and they had refused service under the new scheme? And what about the prospective loss of compensation for their practices if they stayed out? Meanwhile the leaders of the British Medical Association sat back and did nothing, while it was only too evident that the leaders of the Royal Colleges of Physicians and Surgeons had come round behind the Government Then Mr Bevan, in April, made a conciliatory speech, promising an amending Act to make impossible the introduction of a whole-time salaried service by regulation under the present Act, and also to regularize the position of partnerships, so the British Medical Association held another plebiscite in May, with the result that 12,799 doctors were then in favor of accepting service, and 13 891 were against, 48 per cent to 52 per cent The fight was over,

The reasons for this collapse—when victory had been within the grasp of the British Medical Association — make an interesting if depressing study It contrasts sadly with the victorious fight put up by the British Medical Association in Australia with a Socialist Government there, though the first round was won through Australia — unlike Britain — having a written constitution The British Medical Association appealed to the High Court and obtained a judgment that the Act passed by the Socialist Government was unconstitutional Our British Medical Association in Britain is almost too democratic in its structure, its decisions have to be made by an unwieldy Representative Body of some 400 doctors brought together from all parts of the country, and the Executive Council merely carries out its instructions Such an organization is suited to a policy of *laissez faire* and not of quick decisions. In spite of having formed various representative committees, the British Medical Association weakly allowed Mr Bevan to negotiate direct with the Presidents of the Royal Colleges in regard to the specialists, and I have personal knowledge that some of the British Medical Association leaders were less than half hearted in their opposition to a State service Its public relations work was childish—it never even tried to get the voters, the doctors' patients, on its side, and it managed to antagonize the entire press of our country

In contrast, the Australian British Medical Association was backed by the voters, for, during the election at which its Socialist Government was defeated, over 500 family doctors broadcast daily throughout Australia for five weeks, putting the case for the British Medical Association and getting the voters on the side of the doctors The new Australian Government adopted the principle of encouraging voluntary health insurance, using Government funds to amplify the cover against sickness provided by approved insurance organizations, but with special aid to the minority who could not meet the cost of adequate medical care The Government provides all "life-saving" drugs free (such as the antibiotics, sulfa drugs, insulin, serums, including proprietaries), as decided by the British Medical Association Federal Committee Tuberculous patients and pensioners and their dependents have special arrangements But "socialized medicine" as such has been effectively defeated in Australia

I call myself a democrat (with a small "d") but when I look around me, at home, I am sometimes a little shocked to find myself wondering about the intrinsic merit of democracy — the counting of millions of heads as the means of governing a country In Britain we have universal suffrage, for everyone over the age of 21, and the elected House of Commons is supreme Other countries, such as the United States, have wisely adopted the separation of powers and have checks to prevent the abuse of power by the elected chamber But we have no written constitution, and there is no possible appeal from the vote of the Lower House, no appeal to the Supreme Court, that barrier to the encroachment of power that the founding fathers of the United States put to the vagaries of a democratically elected chamber or, indeed, of a president In theory, we have the brake of the House of Lords as a revising chamber and also the royal prerogative of the monarch, but it is a long time since a constitutional monarch (who acts solely on the advice of his or her Ministers) exercised a veto, and the House of Lords has become a retarding (for one year) instead of a revising chamber, though its debates often reach an infinitely higher standard than those of the House of Commons, and still influence public opinion The House of Commons, freely elected for five years, has, therefore, become supreme in our country, and there is no check to prevent its committing the most flagrant abuses, except the threat of a general election When the National Health Service Act had been passed by the Socialist Government the doctors' plebiscite against taking part in the Service received no support from any of the political parties, Socialist, Conservative or Liberal, or from the press — even *The Times* called the British Medical Association policy "emotional" and sneered at "the views of a score of elderly doctors", public opinion was against the doctors, and many responsible persons believed the doctors' continued opposition to the Act to be illegal Mr Frank Byers, one of the Liberal leaders, said in the House of Commons in February, 1948 "Much of the propaganda of the British Medical Association was a direct challenge to the Act, and members of Parliament must resist that."

The hospitals had been taken over by the State and (except for the teaching hospitals) their funds had been confiscated, the income from the National Insurance "panel," on which 19,000 family doctors largely depended, was to end on July 4, 1948, the buying and selling of practices was to cease, and the economic position of the country was such that private practice in medicine was rapidly shrinking All political parties were ready to give the State control over the individual freedom of the doctors. Was it any wonder that opinion in the medical profession was divided? When we attempt to apportion the blame for acceptance of a system of "socialized medicine" by the doctors in England, let us not forget the political atmosphere in which we found ourselves and the fact that we as a nation had just emerged from six years of total warfare

SOCIALIZED MEDICINE AND THE FAMILY DOCTOR.

Today in England and Wales (for Scotland comes under a separate Government Department), 20,859 general practitioners are working in the National Health Service, 17,717 of them "principals," so that there are 3 142 assistants or ' unestablished practitioners " Out of the Health Service altogether there are approximately 1,000 general practitioners — it is apparently difficult to find out the exact number, but that is the figure given me by the Secretary of the British Medical Association About one-half of the established general practitioners are in partnership, for partnerships were a very noticeable development under National Health Insurance and they are still permitted The doctors work, not directly under the Ministry of Health, but under the general direction of 138

Local Executive Councils of 25 members each, seven of them doctors, three dentists and two pharmacists, the others partly nominated by the Minister and partly by the local health authority This set-up is much as it was under the old National Insurance scheme and, indeed, it took over the old Insurance lay staffs and offices, but it is unfortunate that there is little or no liaison between these Local Executive Councils and the Regional Hospital Boards

A general practitioner is allowed a maximum of 4,000 names on his list of patients, if he has an assistant he is allowed an additional 2,400 * It has been calculated that one-eighth of the doctors in general practice have lists of 4,000, and the average is 2,500 in town and 1,500 in the country, where extra mileage payments are made, in addition, there is a varying but small and diminishing number of private patients There is no doubt that a good many of the doctors with large lists are struggling to cope with more patients than they can tackle properly, usually because of their financial commitments A recent careful investigation of the work of general practitioners — as unbiased as any such investigation can be — showed, however, that only about 5 per cent of the doctors "required to revise their methods," and I venture to suggest that this proportion would not be bettered in any part of the world and, indeed, in any type of professional work

The conditions of medical practice are, however, more weighted than ever in favor of the well-established doctor The doctors are paid by a capitation fee for each patient on their list, a method inherited from the old National Insurance system and, indeed, before that, from the old "clubs", whatever may be said about it, it is at least a method with which almost every doctor appears to be content, though the actual amount of the capitation fee is argued about and also whether the first thousand or so on a list should not be paid at a higher rate than subsequent thousands This money is paid into a pool, separate pools for different areas, and then divided among the doctors doing the work in the area Today, includ-

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*These figures have since been modified to 3 500 and 2 000 respectively ing the recent arbitration award it works out at approximately £1 per head, so that a doctor with the average 2,500 list earns £2,500 gross (call it $7 500 to $10,000), out of which he has to meet his professional expenses, which have been officially calculated at an average of 38 7 per cent, there is, in addition, a contributory pension and disability scheme. Naturally the doctors in general practice are inclined to resent any new doctor coming into the area and so diminishing the share-out also, a doctor who has an assistant makes rather more extra out of the pool than he pays the assistant, and he is disinclined to make the assistant a partner, for he reaps no benefit and decreases his own income The attitude of leading doctors in British Medical Association circles with large lists of patients and that of "unestablished" assistants with rather bleak futures before them will naturally be understood to be somewhat different in their approach to this subject Doctors with small practices and beginners in practice may be helped with a small basic payment — they avoid calling it a salary payment and some 2,000 of them are actually receiving this

In order to obtain as accurate information as possible and to correct any preconceived ideas that I might possess, I sent out a questionnaire to a large number of general practitioners with whom I or my friends were acquainted in different parts of the country and with very different types of practice, and I received some 60 answers, many of them accompanied by candid and sometimes pungent letters In addition, I had access to confidential reports on a very thorough first hand investigation of the conditions of general practice since the inauguration of the National Health Act which I am unable to quote in detail but which were certainly enlightening and sometimes surprising For the past three months in view of this paper I have also cross-questioned patients and friends about their relations with their family doctors

The first question I asked the doctors was whether there was any change noticed in the doctor-patient relationship since the National Health Service began in reply only one-third of the doctors considered that it *had* deteriorated, though 3 per cent of the doctors considered that patients looked upon them as a sort of official, and some 25 per cent were of opinion that patients were inclined to look upon them as suppliers of medicines rather than medical advisers Some of my correspondents added amusing stories to this, such a the complete stranger who waved a "temporary visitor's" card at the doctor and demanded a 16-ounce bottle of liquid paraffin and 100 veracolate tablets "and you spell it *Veracolate!*"

Then I asked whether private practice had been affected for the worse by the National Health Service, and the answer in every single case was that it had There were some interesting comments on this question In a certain country town, not far from London, I made inquiries from two partnerships each of three doctors in one partnership only 1 per cent of the work was now private practice, while in the other, 20 per cent of the work was still private practice The latter was exceptional and was accounted for, I think, by the senior partner being a doctor very highly respected and well-known in the district In 50 per cent of the practices, not only in industrial areas but in suburban districts, the doctors have entirely given up private practice as being more trouble than it was worth, for it had almost entirely disappeared in any case

I next inquired whether there was any bureaucratic interference with the doctor's work, except in one instance, the universal reply was that there was no interference or certainly no serious interference The one doctor who was an exception complained of interference and "direction" in regard to his methods of treatment, but I know him to have rather original ideas regarding treatment and I imagine that the fault — such as it was — was not all on one side

Ninety-eight per cent of the doctors questioned stated that patients came to them with trivial complaints more often than before the National Health Service All the doctors stated that attendances at the surgery (the office) had increased, often to a very great extent, 75 per cent of the doctors statel that visits to the patients had decreased, but a few expressed strong views to the contrary One doctor told me the story of his being requested to call upon a certain lady before noon one day, as she had to take her dog to the vet. that afternoon!

I had the temerity to ask all the general practitioners to whom I wrote whether they were better or worse off financially since the National Health Service began, the great majority answered that their financial position was much about the same as before the Health Service, though some of the older doctors were worse off I have received further information through official sources, from which it appears that in actual fact one-third of the doctors in general practice had been hard hit financially, until the recent arbitration award by Mr Justice Danckwerts, who decided that nearly an additional £10,000,000 annually (under the terms of the Spens Committee report) should have been paid to the general practitioners since the inauguration of the National Health Service

The majority of the doctors grumble about the number of certificates required by their patients, though many of them admit that this nuisance is diminishing gradually, an official estimate is that one-third of the doctors are really strict about certification, one-third kind rather than strict, and one third distinctly casual about it, the last section chiefly busy doctors with maximum lists of patients. About 25 per cent of the doctors stated that they worried about the administrative side of carrying on practice — certification, filling up cards and returns, etc.

Few doctors in general practice in towns now do minor surgery, though in the country over 60 per cent of them still do it, as indeed is to be expected I encountered one doctor in the country, however who sent all his patients requiring such minor surgery as the opening of a finger abscess 12 miles away to the nearest hospital

Most doctors on coming across an ear, nose or throat case now send it off without any more ado to a hospital for attention — and at a recent discussion on otolaryngological problems in general practice at the Royal Society of Medicine in

London it was calculated, authoritatively, that from 33 to 40 per cent of patients in general practice had something wrong with their ears, nose or throat. I must say that I now find many cases of wax in the ears among my hospital outpatients — but I refrain from grumbling when I recollect the disastrous results I have seen in my time from "pot-shots" at syringing ears.

Fifty per cent of the doctors in general practice have complaints to make about the hospital services, which they affirm have deteriorated — from their point of view — since the National Health Service. Most hospital outpatient departments now have an appointment system — but the average wait for a consultation is three weeks, and may be six weeks, unless the case is really urgent. The nonurgent inpatient case has an average wait, for admission for operation, of about six months or more, say the general practitioners, orthopedic cases have the longest wait, but ear, nose and throat cases are a good second, and in particular the waiting-list for children's tonsil and adenoid cases has become almost a national joke, for, in many hospitals — though not all, for in some districts tonsil and adenoid operations are now being done at outlying hospitals — it is as long as two years. In London, the Emergency Bed Service, a bureau which keeps contact with all hospitals, has an achievement of getting nearly 90 per cent of emergency cases admitted to some hospital somewhere in London. Aged and infirm patients are a particular difficulty, for the old Poor Law Infirmaries, which admitted them freely, have been turned into general hospitals with only a comparatively few beds for the infirm, tuberculous patients have nearly all to wait many weary months for a bed in hospital.

A complaint of many general practitioners is that they are shut out of the hositals, but when they are cross-examined more precisely there is no general agreement about what they want, though a good many of the junior doctors would like to have paid clinical assistantships in the larger hospitals. Many small "cottage" hospitals, formerly staffed by general practitioners, now have consulting surgeons and physicians attached to them — though some of them are the same men who were the general practitioners, and a number of general practitioners resent in particular being debarred nowadays from giving anesthetics, in favor of rather junior specialist anesthetists

The hospital difficulties, from the general practitioners' viewpoint, are attributable partly to their sending many more patients to hospital for specialists' opinion or treatment, to an increased demand for hospital facilities (especially X-rays) by the patients themselves, to advances in medicine which necessitate hospital treatment, to the abolition of the "charity" factor and the introduction of a free hospital service along with the official propaganda encouraging everyone to make use of it, a shortage of nurses and, in the smaller hospitals of junior medical staff, and to the building situation in Britain in which hospitals find themselves in only the third priority, houses and schools coming before them

Contrary to my expectation, I found, through my questionnaire and from reliable information supplied from other sources, that approximately 70 per cent of the general practitioners in Britain are "reasonably content" with the National Health Service, while 30 per cent say that they feel that their status has altered for the worse and they have a sense of frustration Many doctors who dislike the Health Service, nevertheless feel that it is a great relief to be able to prescribe freely the expensive antibiotic and other new drugs, and also to visit a sick patient as often as may be necessary, without running up a large bill One of the great advantages to the doctor is that a consultant can be called into the patient's home whenever necessary — the so-called domiciliary visits, for which extra payment is made to the consultant, and encouraged under the Health Scheme as helping to lessen hospital care

The old National Insurance Act did not pretend to do more than give the workers general practitioner care of a working-class practice' standard, and it seems to me a pity that this has been perpetuated for the whole population by the National Health Act. The emphasis in general practice is upon quantity rather than quality, the family doctor is not encouraged to improve his professional equipment or to work for higher qualifications, only 6,449 beds out of 500,000 beds in hospitals are in general practitioner hospitals, there is no ladder between general practice and consulting or specialist practice, *and there is a widening gulf between the family* doctor and the specialist The doctor is no longer the guide, philosopher and friend to the family — except, as I gather, in the country, where the traditional relationship tends to persist In the towns, particularly, the visit of the doctor has ceased to be a social occasion, for he is anxious usually to press on to the next patient without wasting time The surgery (office) door is now shut sharp at 7 00 p m when the surgery hour is over, the doctor is no longer building up a practice for himself and is not inclined to do more than his duty — nor, indeed, is more than this expected from him by his patients today This may be only emotion rather than efficiency, but, in spite of the comparative contentment of most general practitioners, something very real seems to have departed from the family practice of medicine in my country

SOCIALIZED MEDICINE AND THE SPECIALIST

The specialists or consultants are appointed by and work under the Boards of Governors of teaching hospitals (of which there are 36 in England and Wales) or, in the case of other hospitals, under Regional Hospital Boards, of which there are 14, each taking in a population of about 3,000,000, in Scotland, there are five Regional Boards, four of them based on teaching hospitals There are approximately 1,500 whole-time specialists in the Health Service, and 4,100 part-time specialists A young specialist appointed to the staff of a hospital at the age of 31 or earlier receives a starting salary of £1,400 (approximately $5,000) per annum, but at the age of 32 he earns £1,700, gradually increasing until a salary of £2,750 (approximately $10,000) has been reached As in the case of the general practitioners, there is a contributory pension scheme In addition, "distinction awards" are given, "in recognition of special contributions to medicine, exceptional ability, or outstanding professional work", 4 per cent of all specialists are awarded the first grade of an additional £2 500 per annum (I understand that only one otolaryngologist has been graded in this category), 10 per cent, the second grade of £1,500 per annum, and 20 per cent, the third grade of £500 per annum The 'awards" are confidential, not public, and made by a committee of retired specialists of high standing of which Lord Moran is the salaried chairman they were planned as an incentive, and have been accepted by our profession, but I confess that I find the whole idea an unpleasant and rather repulsive one Part time specialists receive salaries and awards in accordance with the amount of time (half-day 'sessions") they devote to hospital work. In addition they receive fees (about $15) for domiciliary visits, when called to a patient by a general practitioner It may be worthwhile to note that if a specialist were to receive the highest possible £5,250 in salary and 'award' (about $20,000) income tax would take from this £2 150 plus £580 surtax, if unmarried leaving him £2 580 or approximately $10,000 or if married and with two children, leaving him about £3 030 or some $13,000, few specialists are paid on this scale but most have some private practice as well

There are 2,688 hospitals in England and Wales, 996 of which were former 'voluntary" hospitals, and 1,545 former 'local authority" or municipal hospitals of varying standards Here is the administrative structure of the hospital side of the scheme which may indeed be according to modern Socialistic doctrine but to my mind is against all principles of democracy It is centralized in the Ministry of Health and indeed, in the person of the Minister of Health who, it is true, is responsible to Parliament, which is a popularly elected body There is a Central Health Services Council of 41 members, 21 of them doctors, to advise him but it seldom meets (though I believe that its committees do) and the Minister does not ask for its advice It has been described to me by a prominent member as eyewash' The teaching hospitals have Boards of Governors on which there are a number (less than one-fifth) of doctors representing the hospital staff, and similar numbers nominated by the University and the Regional Board, but the majority of the members are nominated by the Minister Similarly with the Regional Boards, of which there are 14 in England and another five in Scotland, these Boards are nominated by the Minister "after consultation with such organizations as appear to the Minister to be concerned," not elected, and their chairmen again are not elected by the respective Boards, but nominated by the Minister Then come 387 Hospital Management Committees for groups of hospitals, similarly nominated "after consultation with organizations concerned" by the Regional Boards, but also do not elect their own (nominated) chairman All are appointed for three years, but retiring members are eligible for reappointment and, except in rare instances, are in fact reappointed

Now, the interesting thing is that all these nominations were made by Mr Aneurin Bevan when Minister of Health and the left-wing element is well-marked, I will give him credit for having picked good chairmen for most of the Boards of Governors of the teaching hospitals (usually the previous chairman, though with one or two notorious political exceptions), but I should be afraid to trust most of the Management Committee members to run a small-town haberdashery store The Health Service has become the third largest concern in our country, and its enormous administrative staff has a very mixed background, many of the senior "administrative officers," with salaries beyond their wildest dreams, having been local authority clerks of very limited outlook and education It has been emphasized that there are 11,000 ladies and gentlemen giving voluntary unpaid service to hospital management up and down the country — but obviously most of them, to have enough time for their duties and numerous committees, must be retired persons or married ladies with a taste for committees and clubs, except for the few doctors and others with a professional interest

The Conservative Government, which many of us had prayed for, has come into power, but it has so many important problems of finance and defense upon its mind that it *has never got around to considering* the structure of the Health Service and we still have to put up with too many doctrinaire Socialists and superannuated Labor ex-Members of Parliament on our Hospital Boards and Management Committees I was personally told at a committee meeting by one member of a Management Committee, who had been chairman of a former Poor Law Infirmary, that "he was accustomed to doctors who did what he told them!" It makes me sigh for the good old American principle — when the Republicans (or the Democrats) come in, throw the other fellows out!

SOCIALIZED MEDICINE AND OTOLARYNGOLOGY

When I came to consider the effect of socialized medicine upon our own specialty, I thought it wise not to rely entirely upon my own experiences, opinions, and perhaps prejudices, but to collect first hand information from both senior and junior colleagues in different parts of our country, ranging from London (both in teaching hospitals with medical schools and other hospitals), to the large provincial cities (both with medical schools and without), industrial towns in both north and south university centers, seaside resorts, country towns associated with rural cottage hospitals up to the Scottish university cities Altogether I consulted 45 of my friends and colleagues attached to various types of hospital and with widely differing types of practice and my conclusions are founded on the confidential information supplied by them I think perhaps it might give a more colorful impression of what is happening to our specialty if I were to read some of the actual letters I have received, selected because they vary in the district and type of hospital, and also in the seniority of the writers in our specialty, they are edited only by being shortened

Here, for example, is a candid letter from a middle-aged otolaryngologist practicing in a country town and attending a number of cottage hospitals incidentally, he is violently anti-Socialist in his poltical opinions

The domiciliary consultation service has been of real value to folk in rural parts particularly to patients such as cripples and heart cases Before, in order to get a specialist to them meant either charity or drawing on much need savings Now, anyone can have a specialist brought to them if they need it and there is no doubt that many a chronic sufferer has derived peace of mind from the second opinion provided by the domiciliary consultation service The specialist has seen his life greatly altered Nowadays he spends 80 per cent of his time in hospital and 20 per cent or less at his consulting room (office) in an area like this Previously the reverse was the case, or nearly so Private consultations are not uncommon but when it comes to operation then the patient puts for hospital There is one aspect of the case worth considering and that is that before the Health Act private practice was sufficient to support only a limited number of specialists in this area and many of these had to do general practice as well This is very different now, as the following figures show

BEFORE THE ACT	AFTER THE ACT
4 General Surgeons (including E N T, Gynec and Orthopedic, 3 of them were in General Practice)	3 General Surgeons
2 General Physicians	3 General Physicians
1 Radiologist.	2 Gynecologists
1 Anesthetist.	2 E N T
1 Pathologist	2 Ophthalmologists
1 Ophthalmologist.	1 Dermatologist.
1 Psychiatrist.	2 Psychiatrists
	2 Orthopedic Surgeons
	1 Chest Surgeon
	2 Radiologists
	2 Pathologists
	4 Anesthetists
11	26

The hospitals of the smaller but even then growing towns had entirely general practitioner staffs whereas now a full consultant service is available From this it seems evident that the Health Act has greatly extended the scope and availabilities of specialist work in the provincial areas"

The next letter is from a senior colleague of about my own age in a provincial city with a large medical school

"I should say that the Health Service has adversely affected my private practice but not to a great extent. The actual number of consultations has not fallen off very much, but smaller private operation fees both in number and size are noticeable

"Hospital waiting lists have increased and attendance at outpatients departments has increased enormously The reason why more attend the outpatients' department, I would say is that the general practitioners are inundated with work and refer cases more freely than they used to in many cases not stopping to examine the patients thoroughly themselves Immediately the case is deemed an E.N T case an instruction to attend the hospital is given.

I do not think that I have had any particular difficulties with the administration of the Service except that requisitions and alterations alike of buildings accommodation and policy have taken very much longer owing to these matters being passed through several committees before decisions are reached Political bias I think, is distinctly left the number of private beds available has in all cases been reduced and it is fairly obvious that many members of committees would like to abolish these private beds altogether

I would say that juniors registrars and junior consultants are very definitely feather bedded. The salaries today paid to them are I think satisfactory so much so that much of the incentive and drive which was obviously shown by a young man in the past seems to be largely missing The attitude appears to be that they can sit back and await events promotion and increase of salary will follow in due course. No doubt in the past the aim to acquire a private practice whether laudable or not, was a great incentive. My impression is that the young men of today have more or less made up their minds that private practice in the future will be negligible and therefore why bother about it. I think the profession is going to lose something because so many of the young men have adopted this attitude. Of course the other type with a thirst for knowledge and a wish to do well irrespective of any financial reward will always be with us but they are very much in the minority"

Now, here are the opinions of one of the most brilliant of my younger colleagues, also situated in a large city with a medical school

When I was appointed to my hospital, shortly before the National Health Service began, I was selected by a committee consisting of the entire staff of the teaching hospital, some 70 consultants. This means that I was accepted by them as a colleague that I must act accordingly in the future and at the same time feel secure in the knowledge that they selected me to work with them. Nowadays the selection of a consultant is in the hands of a small committee which in fact can sometimes be packed—it is even possible for an appointment to be pushed through by one individual person. The remainder of the staff have no opportunity to choose their colleagues and in fact do not know who is appointed.

I am a part time consultant, I carry out nine sessions a week under the Health Service and spend the remainder of my time in private practice. An advantage of the Health Service for someone like myself with no real financial backing is that I was paid for the sessional work from the beginning of my appointment and therefore had a guaranteed income from which to build up a home and security The period of waiting for a private practice to appear was therefore eased however had there been no Health Service I should have had two difficult years during which I should have had to borrow a sum approximating to my income from the Health Service I should however have been secure in my third year and able to pay back the borrowed money fairly rapidly The E.N T private practice in this area is more healthy at the moment than most of the other branches of medicine and surgery If I had been in some of the other specialties I should have not been able to become secure and pay up my debts in the same time

“I cannot see that the hospital services supplied in my department have improved as a result of the Health Service We have no more beds no more nurses no more assistants and a longer waiting list The Teaching Hospital is more fortunate than nonteaching hospitals in that its internal administration has been rather better preserved The Endowment Funds have been retained as a research fund and this is available to us

‘I have also been on the staff of a small hospital on the outskirts of the city for the past year This hospital is far more affected by the National Health Service and in every way it has been for the worse Before the Service it was a small unit supplying the needs of a town of 50 000 inhabitants It was run by a combination of general practitioners and visiting consultants It was thoroughly solvent and had funds for rebuilding It is now the poor relation of the group of former local authority hospitals in the area and is administered by a rival hospital in the nearby town Its funds have been appropriated by the Ministry and it has proved impossible to obtain funds for anything other than very patchy repairs The standardization of salaries for the resident staff in all hospitals has made it particularly hard hit and the situation as regards internes is quite hopeless The medical consulting staff have no say whatever in the running of the hospital

The following are extracts from a letter from an established otolaryngologist in an industrial town

‘My own private practice is barely half what it was prior to July 1948 and in this I am extremely foruntate compared with many of my colleagues in this area particularly with my surgical colleagues whose private practice is now virtually nil

In the early stages the domiciliary consultation system was simply dreadful and on many occasions I arrived home in the evening and found a veritable visiting list. Being unable to contact the patients doctors I had no option but to go and see the various patients By personal contact with the men in practice and by making suitable arrangements for the reception of emergencies at the hospital it has been possible to stop the abuse of the domiciliary consultations and now these are infrequent’

The next letter comes from a senior colleague on the staff of a famous London teaching hospital

Private practice is still busy but in an entirely different way Possibly we see more patients for an initial consultation When a question of operation arises patients avail themselves of their privileges and go into the general wards Parents however tend to break into capital and pay something if they can get their children s tonsils and adenoids done more quickly The fact that patients do not like waiting around hospitals accounts for their willingness to pay a substantial fee to be seen for the first occasion in private Private patients are not surprised if a high fee is asked for an operation (higher than before the war) but in my experience they will not pay the higher fees and I personally remain at the prewar level

Our Board of Governors only have two really troublesome Socialists among the members and on the whole I think that the Chairman handles them fairly well They both make every mortal thing a political issue based on prejudice and virulent class hatred. They make out a reasonable case for the welfare of the patient but this is utterly overshadowed by their prejudice against the consultant staff

"The only trouble we have had with appointments to the Consultant Staff has been from outside assessors who have wished on us strangers we didn t really want

The next letter comes from a senior colleague of my own age on the staff of a large teaching hospital in the North

I have dropped 25 per cent of my private work. My accountant tells me that I am very lucky many colleagues apparently having suffered very much more I am sure that the training nowadays is much better than it was in my day The young men get better opportunities to do things and realize the necessity to read not merely the textbooks but also the journals for examination purposes these being on a higher level I think, also makes for better training

I do not find any political bias as such in the Regional Board but without a doubt the tendency here is to make every possible appointment whole-time and every opportunity is seized to act accordingly in spite of all our protests This Region is far too big and its work is months behind.

As regards increase of lay staff I cannot give you an accurate number but I have no doubt that a conservative estimate is threefold And much of it very poor quality All kinds of people have been upgraded porters and clerks to become heads of departments who are quite unfitted for their new jobs And of course, at about three times their original salaries or more Much frustration and stultification is the result.

The long and short of it is that one is not pushed to give one s best to the job I still have a few more years to go and I may well clear out of it before then.

By way of contrast the following are extracts from the letter of a young friend of mine of 'Registrar" status at a teaching hospital in London

"The opportunities are good from house surgeon to Senior Registrar but at this point the opportunities become far too few Too many consultant appointments are for too few sessions A man with a family can not afford to leave a full-time appointment as Senior Registrar (£1 000 to £1 300) to do three sessions say as a Consultant (£465) in the hope of getting other sessions or some private practice He depends largely upon a maximum part time job—nine sessions. There have been only two of these advertised in the last 18 months—1 Norfolk and Norwich and 2 Dundee. For the Norfolk vacancy there were 22 applicants There will now be a "pool" of about 25 suitably qualified people waiting for a consultant post and no posts coming up There are four reasons for this 1 There are not as many new consultant posts as were promised when the Health Service started 2 There were too many trainees after

> the war—from the Services 3 Some consultants are being kept on after they are due for retiral 4 Some consultants are doing more than nine sessions part time This shortage of consultant posts is by no means imaginary I myself know of three junior otolaryngologists who are about to emigrate
>
> There really is a big gap between the number of Senior Registrar appointments and the Consultant posts available and there is a lot of strong feeling among Senior Registrars about this particularly the feeling that something could be done about it and is not being done about it
>
> May I finally (merely by way of an example) state my own case? Assuming that I were to complete my four years as a Senior Registrar without getting a consultant job (and it is by no means guaranteed) I would have this record Age 37 married two children (both at school), 10 years in E N T work 13 years qualified F R C S D L O quite unacceptable in general practice No job very likely in the E N T world It s not a very happy picture, I think you'll agree

Finally, here is a forthright letter from a young consultant, appointed since the war to a teaching hospital in London

> My private practice has grown very slowly and I am glad I do not have to live on it for it has never met the expenses of my consulting room and car A junior colleague who was elected to the staff of a famous teaching hospital two years ago told me that he had only two operations in private in the last four months
>
> ' The same fees are charged for operations now as before the war The nursing home or private hospital fees however are now so high that few middle-class patients can afford them Fortunately a short stay is usual in our specialty, but in other specialties the private ward fees are killing private practice A neurologist at Queen s Square for example will probably need to keep his patient for some weeks and the private ward fee is £23 a week St Peter s Hospital for G U Diseases is even worse for here the fee for a private ward is £30 pounds a week The Elizabeth Garrett Anderson Hospital private fees have gone up from three guineas to 30 guineas a week
>
> The question of training specialists is very difficult The salary of the registrar was fixed by the State in the beginning to allow a reasonable standard of living during his apprenticeship the result was that competition for these appointments has become more severe because the prospect of life as a specialist is pleasanter than that of a general practitioner There are for example 12 registrars at the Royal National Hospital Gray's Inn Road compared with only one before the war The prospect that all these men will reach consultant rank is doubtful Away from the teaching hospitals the opportunities for practical work are good but no Registrar leaves a teaching hospital if he can help it as he thinks—rightly—that he will lose his chance of promotion if he does Many provincial hospitals are therefore without junior help and the surgeon has to do the Registrar s work and sometimes even act as his own House Surgeon
>
> It must in fairness be said that the junior consultant like myself has gained from the State Service I have now a certain income which is more than I could have hoped for if I relied on private practice I think I should be wise also to look to the State for my future income

> rather than to private practice. The estate agent for Harley Street told me a *few days* ago that he was trying to alter the regulations of the neighborhood to allow consulting rooms to be let to professional men of *all kinds* and *not only to doctors* as the demand for consulting rooms had fallen off greatly since the State Service
>
> "The primary F.R.C.S is now at a level of a first-class honors degree. The future consultant will therefore be more gifted academically than he has been in the past, and it remains to be seen whether he will have the other capacities necessary to make a good doctor
>
> "The next generation of doctors will be more *tightly controlled* and their standard of living will go down At present, however a consultant of my age lives well My income is more than I could have hoped for my work fills my day without being exhausting and the State control lies lightly upon me.

Such, then, is the position in our own specialty, much of it doubtless due to the general economic conditions of our country rather than to the Health Scheme itself The older consultants are in the main disenchanted but resigned to their fate, the younger consultants seem content enough and perhaps a little complacent, and the juniors who have not yet reached consultant rank seem to feel that they have a right to a consultant appointment, but it is doubtful whether they will ever get it. The comparatively few teaching hospitals have been particularly favored in many ways, but the position of the hundreds of other hospitals has been distinctly worsened

CONCLUSION

The main problem of the *National* Health Service *today* is how our country is to meet a potentially unlimited demand for increasingly expensive medical care from limited resources Contrary to popular belief, the Health Service is paid for almost entirely out of general taxation and not by the weekly insurance contributions which everyone has to pay in our country An employed man and his employer pay nine shillings and five pence between them (about $1 50), and a self employed person six shillings and six pence (about $1), employed women pay slightly less than men, and married women pay about half a dollar This adds up to quite a sum in the course of a year but only 10 pence a week is diverted to Health Service expenses, the rest going to sickness, unemployment, old age and burial insurance

The finance of the Health Service has gone completely haywire. It was calculated originally to cost £132,000,000, according to the Coalition Government "White Paper" of 1944, and it was estimated that it would be some years before it would cost £10,000,000 for dentistry and £1,000,000 for eye services—*in actual fact, in the very first year of the Health* Service dentistry cost £28,000,000 and ophthalmic services £20,000,000. Mr Aneurin Bevan, when he put forward his National Health Service Bill in 1946, calculated that the complete service would cost £152,000,000, but in the first year of its operation under his direction the Service cost £227,000,000, and this was only a beginning: in 1949-50, the total *reached £358,000,000, and in 1950-51 it was £460,000,000.* The Treasury then stepped in and fixed an arbitrary ceiling for the Health Service of £400,000,000 annually, which nevertheless, has just been exceeded through the Danckwerts award of increased remuneration to the general practitioners. This figure takes little or no account of the millions of capital expenditure necessary to bring up-to-date the hospitals — many *of them badly war-damaged — and to increase the number* of their beds, for which there is a greatly increased need.

The story of the drug bill shows what happens when no curb is put to the free provision of medicines, dressings and appliances. In 1948-1949 the drug bill was £17,715,000, but last year it exceeded £50,000,000 (or about $200,000,000), an average of £1,476 for each general practitioner, about the same as his own net income from the State, and the checking of the chemists' bills is between seven and 12 months in arrear. Last year, 21 per cent of all prescriptions dispensed were for proprietary preparations, which appears to be an unnecessary extravagance. No wonder the Conservative Government has just imposed a charge of one shilling on each prescription (as well as certain charges for appliances) in order to cut down excessive and unnecessary resort to doctors and pharmacists! Incidentally, 200,000 Government hearing-aids have been issued to deaf patients, and no charge is being made for them yet because the waiting-list already is so lengthy.

Before the last war — as our Socialist friends are apt to forget — nobody in our country needed to be without a doctor Our profession was of as high a standard as any in the world, and had long been accustomed to charge fees in accordance with the circumstances of the patient. Nineteen million workers were cared for under National Health Insurance, their uninsured dependents paid modest fees to their family doctors, and for persons in actual poverty a Poor Law doctor was provided by the local authority The hospitals, working independently throughout the country, were kept up by charitable donations from the people in comfortable circumstances and by the regular weekly contributions of a few pence by those less well off, who were accustomed to use the hospitals Until World War II but few of our voluntary hospitals were in debt to any serious extent, and they were able to pay their way, despite the increasing cost of hospital care even then The middle classes — who are said to have welcomed the National Health Service most of all — did not care to accept charity in the public wards of the hospitals but were being cared for by a rapidly increasing number of private wards and private blocks in hospitals in which modified charges were made After World War II, in spite of the economic position of the hospitals and indeed, of the country, all that was required to develop the medical services of our country to an adequate degree was financial support for the hospitals and the encouragement of insurance schemes, and it was, in my opinion, quite unnecessary to launch a National Health Service so precipitately and without more consideration I have endeavored to explain, however, how politics and economics in conjunction, brought it into being, and what matters now to the politicians is to continue to give some sort of universal service, even if its standard has to be lowered

If a country wishes to avoid "socialized medicine," I should say Stay prosperous, avoid wars — and put not your faith in the politicians It takes a very long spoon to sup with the devil, and political astuteness is not a quality commonly possessed by doctors — certainly not in my country Nobody really likes doctors' bills or hospital charges, and our National Health Service is undoubtedly popular with all the political parties and also with the voters Ninety-seven per cent of the population have put their names down on the Health Service doctors' lists, and last year 75 per cent of them actually made use of the Health Service

It is wrong, in my opinion, to condone the system of socialized medicine merely because — so far — it has turned out to be not quite so bad as the doctors expected We have experienced but the first step and if in a few years' time we again have a Socialist Government — as we may well have, for Mr Churchill's Government has an all-over majority of only 17 — we shall have to put up a serious fight for the maintenance of private practice, which the Socialists are determined to smash if they can The doctors will have to do as Sarah Bernhardt and Coquelin did long ago with the Comedie Francaise, to the dismay of their faint-hearted colleagues — throw away their salaries and their pension rights, and step boldly into the arena of independent practice They must seek the support of other professions in the struggle against the cannibalism of the State, for the fight is not only up to the doctors, dentists and medical auxiliaries, but to all professional men and women, lawyers, teachers, engineers, accountants, architects, even artists

The cost of all professional services (along with the cost of education and training) has risen almost above the ability of the average citizen to pay for them, yet the scope and necessity for their utilization has enormously increased As a result, there is in our country an increasing proportion of professional people in direct or indirect State employ only 52 per cent of registered architects and less than two-thirds of incorporated accountants are today in private practice, and the dependence of private practitioners (lawyers, architects, consulting engineers and others) on Government or local Government work is well known (Roy Lewis, 1952) The scientists have been swept into the service of the State to an extent not generally appreciated our Government operates some 600 research establishments, and in 1945 formally created the 'Scientific Civil Service."

The Hippocratic code has influenced the conduct not only of generations of physicians, but that of other professions also — scientists, engineers, lawyers, artists have all developed as strict a professional conscience as we have The main ethical principles for all of them are devotion to truth and a sense of responsibility towards the patient or the client, in return for his trust. The code of any profession depends upon the tradition of the ethics of private practice, and if private practice disappears the old tradition will lose its influence upon the new generations of its students and practitioners While private medical practice survives in our country — while there are 4,000 out of over 5,600 specialists and even 1,000 out of 21,000 general practitioners still in independent practice — the old tradition and the old professional conscience will survive and set the tone for the whole profession and indeed, for the other professions who have taken their standard from the medical ideal but if private practice were to disappear altogether — what then? I should like to quote the words which Mr Roy Lewis, who is not a doctor, wrote in the *British Medical Journal* the other day Let us make no mistake,' he wrote, 'when all professional people are officials, there will be no doctors, no lawyers, no artists, and probably no scientists either There will be no professions, and no life worth living'

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Dr Hugh Clegg, and Dr Angus Macrae, the Secretary of the British Medical Association, have been very kind, and Dr E E Claxton, the Assistant Secretary of the B M A who deals with the Consultants and Specialists Committee, was particularly helpful in directing me towards sources of first-hand information and statistics The President of the Royal College of Surgeons, Sir Cecil Wakeley, Bart, and the Honorary Secretary of the Fellowship for Freedom in Medicine, Dr E C Warner, are among others to whom I am grateful for information and advice

Besides the books and articles to which reference is made below, I have consulted many pamphlets, reports and memoranda published by the British Medical Association, notably "A General Medical Service for the Nation," 1938, the Medical Planning Commission's "Draft Interim Report," 1942, "Tuberculosis and the National Health Service," 1950, the "Summary of Main Current Figures, England and Wales, of the National Health Service," June, 1951, also the "Annual Reports" of the Ministry of Health, particularly that for 1950, published in December, 1951, Sir William (now Lord) Beveridge's "Report on Social Insurance and Allied Services," 1942, and the Central Health Services Council's "Report on Cooperation Between Hospital, Local Authority and General Practitioner Services," 1952

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CENTRAL ILLINOIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

The next meeting of the Central Illinois Society of Ophthalmology and Otolaryngology will be held at the Abraham Lincoln Hotel in Springfield Ill, on Sept 12 13 and 14 The guest speakers will be Dr Paul A Chandler, of Boston Mass, and Dr Thomas C Galloway, of Evanston Ill

NASAL AND PARANASAL SURGERY — A RECONSIDERATION OF FORMER METHODS*

GEORGE L WHELAN, M D,
Philadelphia, Pa

Many forms of treatment of sinusitis now prevail and seem to be on the increase They include "the allergic management" local intranasal treatments which consist of conservative sinus irrigations, the use of chemotherapy and the antibiotics in the early stages, etc , however, we frequently overlook something much more important, such as the indications for more extensive surgical procedures A conservative trend is developing, probably because almost everyone today thinks in terms of conservative management Thus in those cases in which surgery is actually indicated, such procedures are frequently delayed or overlooked The objective in any form of treatment is ultimate and possibly permanent improvement to the patient, that is to say, improvement in function The patient is interested only in having a nose that gives him good service, and if surgery is indicated, the patient should be given the benefit of such surgery The thought occurred to me that it would be well to review some intranasal conditions which may or may not be amenable to conservative management

There seems to be a group of borderline cases which cannot always be definitely placed in either the medical or surgical classification Such patients should be given the benefit of intelligent medical care before surgery is considered They should be treated for a period of from four to six weeks, then if they do not respond favorably to treatment they should be managed surgically Occasionally patients present themselves for treatment in the clinics and private practice who have

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had months or years of ineffectual minor surgical manicuring of various types or a medical treatment which had no reasonable justification The examiner who had previously treated such a case may have overlooked the fact that the pathology was in the sinus lining and not always in the nose He may have failed to realize that all of the existing circumstances preclude any hope of success from the various local efforts A certain line of treatment may have been *followed* because it had been described and not because it produced the desired result. When such existing intranasal conditions have been carefully studied and treated, without responding to such controlled treatment, we should then without further delay resort to surgical intervention

Submucous resection of the nasal septum is one surgical procedure which is now rarely performed Today enthusiasm seems to be swaying away from that operation There are however, many cases where a submucous resection is a necessary procedure regardless of any other management of intranasal conditions. Some of these conditions include cases where the patient shows a markedly deflected or thickened nasal septum which interferes with normal breathing whether or not such a condition is associated with an allergic state where medical treatment has not helped Such an obstruction to normal breathing causes the patient much discomfort, and surgical intervention would seem to be indicated[1] In such a case most rhinologists agree that the patient should be given the benefit of this kind of surgery By removing the obstruction the patient will experience considerable relief The fibrous contraction between the mucous membrane flaps after removal of the blocking septum establishes a better airway for the patient. If such a patient is being managed only from the allergic standpoint this result may not be accomplished

A deflected nasal septum which interferes with the treatment of any intranasal condition, such as polypi or infection in the anterior or posterior ethmoid cells, should be operated upon to facilitate the surgical approach Unless this operation is done, polypi or diseased ethmoid cells which are inac cessible to instrumentation cannot be operated upon satisfactorily intranasally When this procedure is done, the thorough surgical removal of diseased tissue is possible

For the same reason, any intranasal manipulation, such as irrigating the antra, or when contemplating other intranasal procedures, such as an *antrum window*, the bony septum should be removed if there is not sufficient room in which to perform the procedure successfully Not infrequently a submucous resection of the nasal septum may be necessary to obtain sufficient room for an antrum puncture In such cases removing a spur which blocks the approach beneath the inferior turbinate, together with removal of the bony nasal septum, will render the area much more accessible for future irrigations and also allow sufficient room to elevate the anterior third of the inferior turbinate if necessary

Pressure[2] by septal ridges against the upper nasal areas is still a cause of headaches, which symptom is frequently relieved by removal of the obstruction and pressure caused by the septum

The maxillary sinus may present a subacute or chronic sinus infection which may not yield to treatment by irrigations The patient may be carefully studied by opaque fluid and X-ray, and no polypi or pathological mucous membrane may be demonstrable In such a patient one may hesitate to do an extensive maxillary sinus operation The subacute maxillary infection may readily yield to the large antral fenestration There are some rhinologists who prefer this method to a Caldwell-Luc operation, and report satisfactory results[3] My experience with this procedure has been satisfactory in selected cases

Polypi sometimes do seem to recur after removal Allergists seem to be of the opinion that the growth of polypi can be controlled by allergic management Some of the cases seen and studied in the clinics as well as in private practice had previously been studied and allergically managed without benefit to the patient It is the duty of the rhinologist to give such patients the benefit of such surgery as may be indicated

Surgical neglect of such patients may happen if we are overwhelmed by the current trend In some cases removal of polypi surgically may be indicated.

When tissue which has been carefully examined (this includes the so-called allergy-ridden membrane) and found to be chronically inflamed and infected and the distribution of infection within the membrane is such that the patient's health as well as his comfort is impaired, surgical removal should be considered, preferably through a thorough or radical operation. In such cases the external approach in competent hands gives promise of a good result. When tissue is pathologically diseased and ceases to function normally it should be removed

Much has been written about operative interference in acute sinus conditions, notably the frontal sinus If taken too seriously, this is apt to lead into difficulties many operators who follow blindly the pronouncement of those authorities We know there are certain acute cases in which surgery is dangerous, we must also consider that there are many fulminating cases of frontal sinusitis which require immediate and complete drainage for the safety of the patient. The rules which govern general surgery apply here, with necessary allowance for the difference in the anatomical structures involved, therefore, to lay down a hard and fast rule without qualifications and to try to treat all cases by this rule may be a very dangerous policy Each case should be evaluated on its own merits and operated or not, according to the indications present. In the earlier days of frontal sinus surgery the tendency in operating was to do too little, then came a period of radical surgery, and now we are in danger of going back to the ultraconservative attitude No surgery, or incomplete sinus surgery may be responsible for the present day feeling of hesitancy in operating when extensive sinus surgery is indicated

When we do operate on acute cases in which immediate surgical intervention is indicated we should try to secure thorough and complete drainage using every additional aid to our surgery, such as transfusions, chemotherapy, etc An incomplete or an inadequate operation, when extensive surgery is indicated is simply an aggravation lowering the local and general resistance of the patient and failing to secure good aeration and drainage Complications of meningitis and brain abscess are occasionally seen in acute fulminating cases Such cases demand early and complete exposure and drainage We do not hesitate to operate early upon an acute mastoid, so why lay down a special set of rules for the frontal sinus?

A chronic frontal sinus infection may occasionally respond to intranasal drainage One hesitates to use a rasp to enlarge the nasofrontal duct, because of the possibility of callous formation and perhaps later a blocking of the nasofrontal duct, however, much benefit may be obtained in some cases by thoroughly removing the anterior third of the middle turbinate[4]

The sphenoid sinus is probably neglected more than any other sinus because of its difficult location The approach is made more difficult when a large middle turbinate, thickened nasal septum, or a bulging septal dislocation blocks surgical manipulation Were it not for those two structures, the sphenoid sinus would be less frequently neglected One reads not infrequently of cases of meningitis of obscure origin, only to find at postmortem examination an infected sphenoid sinus which had perforated into the cranium Thorough anesthetization of the middle turbinate and septum with cocaine-adrenaline solution will enable the operator to reach the sphenoidal osteum for irrigation without discomfort to the patient A flexible small catheter may be used In view of the seriousness of complications which may arise from the sphenoid sinus, the removal of the middle turbinate as well as removal of a thickened bony nasal septum, to facilitate entrance to the sphenoid sinus should be considered If the inflammatory process in the sphenoid sinus does not confine itself to the mucoperiosteal layer, but extends to the walls with bony destruction, very serious consequences may ensue

Sudden unilateral blindness has been observed According to Hajek,[5] the blindness is caused by either compression of the optic nerve in the optic foramen or by perineuritis A destruction of the dividing wall between the sphenoid sinus and the optic foramen may also occur The rupture of serous or suppurative secretion into the retrobulbar tissues may lead to exophthalmos By extension of the inflammatory process through the optic canal, meningitis may occur The symptom-complex exophthalmos and sudden blindness in the presence of a suppuration of the sphenoid sinus indicates that extension of the process to the orbit has taken place. Tumors of the sphenoid may also produce the same symptom-complex. Proetz[6] suggests that in operations upon the sphenoid sinus the osteum should remain intact, and the sinus approached medial to the osteum. This is a point well taken

New growths within the nasal cavity, such as bleeding polypi or polypoid tissue, should not be treated too lightly Sufficient tissue for biopsy from several areas should be removed Such tissue should also be removed when it is causing obstruction, thereby preventing proper aeration and drainage of the sinuses.

Early cancers of the paranasal sinuses may be silent lesions, consequently, the diagnosis in many cases is made after the lesion has become extensive This is all the more reason therefore, why the patient should be given immediate and adequate treatment This treatment, if it is to be successful, cannot be applied routinely Rather, each case must be individualized and carefully evaluated Cancer of the sinuses has always been extremely difficult to manage To be effective, surgery must be radical, likewise radiotherapy is seldom effective unless it is radical and well planned Even with what has been considered the best of treatment, however, results are not too encouraging If such cases can be diagnosed early and the existing conditions are amenable to radiation or surgery when indicated, we may possibly prolong the patient's life

NASAL FIBROMA

Much is written about this topic and the difficulties experienced by the operator in surgical procedures in this area, however, there are a number of cases where the surgical approach may be helped by removal of the middle or inferior turbinate, permitting access to the posterior area of the nose, making intranasal surgery possible A Tyding snare may prove helpful in removing this growth in part or *in toto* without experiencing too much difficulty One should, of course, be prepared to manage loss of blood by transfusions, by administering plasma or by packing

While it may be wise to limit our surgery to the intranasal approach, such an approach frequently being less incapacitating to the patient, one must not avoid the external approach when necessary The Caldwell-Luc operation, for instance, in dealing with extensive pathology in the maxillary sinus could be the only adequate procedure in many instances The frontoethmosphenoid operation through a small incision at the nasal dorsum with proper instruments and lighting, such as described by Lynch,[7] Sewell and Ferris Smith, have replaced disfiguring operations, such as those described by some of the older operators, Hajek, Fine and others This is proper because when properly executed all the necessary surgery could be accomplished In a very large frontal sinus with deep frontal recesses the modified Killian operation, leaving a frontal ridge to lessen the deformity, would seem to be indicated

When osteomyelitis of the frontal bone is present, however, disfigurement is not to be considered, because the life of the patient is at stake On the other hand, such conditions as orbital abscesses, ethmoiditis with polypoid formation, which cannot be adequately treated intranasally, are quite amenable to the approach by a small extranasal incision The effects of the antibiotics upon the clinical symptoms may obscure the picture and cause us to lose sight of the fact that the pathological process may be extending, even though the temperature, blood count, etc, seem to be within normal limits For this reason cases being treated with these agents should be studied with careful scrutiny and vigilance should be maintained for some time after the discontinuance of the drug, to make sure that a recurrence of the infection does not develop

Intracranial complications resulting from sinus infections should definitely be included in the realm of otolaryngology and the otolaryngologist should be fully equipped to manage such complications as emphasized by Shuster[8] in his paper read before the American College of Physicians in February of this year

We feel that a helpful suggestion in the right direction may be for the rhinologist to keep careful records of surgery performed throughout the year, directing particular attention to the types of sinus surgery performed upon patients with associated chest involvement, or with threatened intracranial or intraorbital complications, or with other complications with definite indications for sinus surgery Postoperative results could be evaluated and a record kept, including symptoms indications for operation and postoperative results in each case These records could then be pooled Later the pooled statistics from the various hospitals could be published with a final evaluation of end results. Such information might prove to be a most helpful guide in selecting the proper surgical procedure to obtain the best results in a given case Many of the effects of improper surgery, and the criticism developing therefrom could thus be avoided, with considerable benefit to the patient.

SUMMARY

An attempt is made to call attention to a number of existing cases where intranasal surgery or the external approach may be indicated The trend to conservative treatment may sometimes cause us to overlook such cases We should guard against being swayed too much by the trend, and it would seem that we should remember that there still exists a number of cases which require surgery The inclination to be conservative by intranasal surgery must not stand in the way of extensive nasal surgery if the patient's life is in danger

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BOOK REVIEW

Speech Training A Handbook for Students By A Musgrave Horner, Lecturer on Speech Training at Stranmillis College, Belfast. 176 pages with index and eight figures New York Philosophical Library, 15 East 40th Street, 1951 Price $6 00

For those interested in improving speech this book contains a series of practical exercises which should be extremely valuable It is not an advanced book but should be useful for the beginning student.

S R. S

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION

August, 1952

Audicon Models 400 and 415

Manufacturer National Earphone Co., Inc., 20-22 Shipman St., Newark 2 N J

Audivox Model Super 67

Manufacturer Audivox, Inc., 259 W 14th St., New York 11, N Y

Aurex Models L and M

Manufacturer Aurex Corp., 1117 N Franklin St. Chicago Ill.

Beltone Symphonette, Beltone Mono-Pac Model M

Manufacturer Beltone Hearing Aid Co. 1450 W 19th St. Chicago Ill

Cleartone Model 500, Model 700, Cleartone Regency Model

Manufacturer American Sound Products Inc. 2454 S. Michigan Ave., Chicago 16 Ill.

Dahlberg Model D-1, Dahlberg Junior Model D-2

Manufacturer The Dahlberg Co., 2730 W Lake St. Chicago 16 Ill

Dysonic Model 1

Manufacturer Dynamic Hearing Aids 43 Exchange Pl., New York 5 N Y

Electroear Model C

Manufacturer American Earphone Co., Inc., 10 East 43rd St., New York 17 N Y

Gem Hearing Aid Model V-35, Gem Model V 60

Manufacturer Gem Ear Phone Co Inc., 50 W 29th St., New York 1 N Y

Maico UE Atomeer, Maico Quiet Ear Models G and H, Maico Model J

Manufacturer Maico Co., Inc. 21 North Third St. Minneapolis 1, Minn

Mears (Crystal and Magnetic) Aurophone Model 200, 1947—Mears Aurophone Model 98

Manufacturer Mears Radio Hearing Device Corp , 1 W 34th St., New York, N Y

Micronic Model 303, Micronic Model "Mercury", Micronic Star Model

Manufacturer Micronic Co , 727 Atlantic Ave Boston 11 Mass

Microtone T5 Audiomatic, Microtone Classic Model T9, Microtone Model T10, Microtone Model T612, Microtone Model 45

Manufacturer Microtone Co Ford Parkway on the Mississippi, St. Paul Minn , Minneapolis 9 Minn

National Cub Model C, National Cub Model D (Duplex), National Standard Model T, National Star Model S, National Ultrathin Model 504, National Vanity Model 506

Manufacturer National Hearing Aid Laboratories 815 S Hill St. Los Angeles 14, Calif

Otarion Model E-4, Otarion Models F-1, F-2 and F-3, Otarion Model G-2, Otarion Model G-3

Manufacturer Otarion Hearing Aids, 159 N Dearborn St , Chicago Ill

Paravox Model D, "Top-Twin-Tone", Model J (Tiny-Mite), Paravox Model XTS (Xtra-Thin), Paravox Model Y (YM, YC and YC-7) (Very-Small)

Manufacturer Paravox Inc , 2056 E 4th St., Cleveland, Ohio

Radioear Permo-Magnetic Multipower, Radioear Permo-Magnetic Uniphone, Radio Ear All Magnetic Model 55, Radioear Model 62 Starlet, Model 72

Manufacturer E A Myers & Sons, 306 Beverly Rd , Mt. Lebanon, Pittsburgh, Pa

Rochester Model R-1, Rochester Model R-2

Manufacturer Rochester Acoustical Laboratories Inc 117 Fourth St. S W., Rochester Minn.

Silvertone Model J-92 Silvertone Model P-15

Manufacturer W E Johnson Mfg Co 708 W 40th St., Minneapolis Minn.

Distributor Sears Roebuck & Co 925 S Homan Ave. Chicago 7 Ill

Solo-Pak Model 99

Manufacturer Solo-Pak Electronics Corp Linden St., Reading Mass.

Sonotone Model 700, Sonotone Model 900, Sonotone Models 910 and 920, Sonotone Model 925, Sonotone Model 940, Sonotone Model 966

Manufacturer Sonotone Corp. Elmsford N Y

Superfonic Hearing Aid.

Manufacturer American Sound Products Inc 1303 S Michigan Ave. Chicago 5 Ill

Televox Model E

Manufacturer Televox Mfg. Co 1307 Sansom St., Philadelphia 7 Pa

Telex Model 97, Telex Model 99 Telex Model 200, Telex Model 300B, Telex Model 400, Telex Model 500, Telex Model 1700

Manufacturer Telex, Inc., Telex Park Minneapolis 1 Minn.

Tonamic Model 50

Manufacturer Tonamic, Inc., 13 Russell St., Everett 49 Mass.

Tonemaster Model Royal, Model Cameo

Manufacturer Tonemasters Inc., 400 S Washington St. Peoria 2 Ill.

Unex Midget Model 95, Unex Midget Model 110, Unex Models 200 and 230
Manufacturer Nichols & Clark, Hathorne, Mass

Vacolite Models J and J-2
Manufacturer Vacolite Co, 3003 N Henderson St., Dallas 6 Tex.

Western Electric Models 65 and 66
Manufacturer Audivox, Inc, successor to Western Electric Hearing Aid Division, 259 W 14th St., New York 11, N Y

Zenith Model 75, Zenith Miniature 75, Zenith Model Royal, Zenith Model Super Royal
Manufacturer Zenith Radio Corp, 6001 Dickens Ave, Chicago Ill

All of the accepted hearing devices employ vacuum tubes

Accepted Hearing Aids more than five years old have been omitted from this list for brevity

TABLE HEARING AIDS

Aurex (Semi-Portable)
Manufacturer Aurex Corp 1117 N Franklin St Chicago 10, Ill

Precision Table Hearing Aid
Manufacturer Precision Hearing Aids, 5157 W Grand Ave Chicago 39, Ill

Sonotone Professional Table Set Model 50
Manufacturer Sonotone Corp Elmsford, N Y

All of the Accepted hearing devices employ vacuum tubes

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RHINOLOGY IN CHILDREN
RESUME OF AND COMMENTS ON THE LITERATURE FOR 1951

D E S WISHART, M D , J B WHALEY, M D , and
W B WALLACE, M.D ,
Toronto, Canada

This resume is the product of three members of the Otolaryngological Staff of the Hospital for Sick Children, Toronto It covers the *Journal of the American Medical Association*, the *Canadian Medical Association Journal*, the *British Medical Journal*, the *Lancet*, the four main British and American otolaryngological journals, and six pediatric journals. The articles have been roughly classified under the headings previously used, and follow almost the same order

GENERAL ARTICLES ON RHINOLOGY

Kempton[1] *discusses* a very common picture of general ill-health associated with chronic or relapsing respiratory infection and having its greatest incidence in the first years of school life General debility and fatigue, recurring colds, and recurrent or persistent cough are common symptoms along with various other manifestations of minor or borderline ill health — pallor poor or fickle appetite with failure to gain weight, indigestion and bilious attacks, and interference with sleep The picture varies greatly in detail and degree He notes that Eustace Smith, in 1899 described these children as suffering from 'mucous disease , that G F Still thought

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them were landed equipment stores and all necessities so that no personal contact between them and the mainland should be necessary for about three months In the preliminary isolation period of 10 weeks, colds occurred in five individuals, which rapidly cleared up and there were no more during the isolation period Then the party separated into three groups, A, B and C, which thereafter lived and cooked in separate buildings, and the island was divided into three territories, to one of which each party was restricted

On Sept 19, two of the authors landed and joined Party C to see whether normal cold-free people could carry cold virus in their respiratory tracts or elsewhere on their persons and so convey infection to the "islanders" No colds developed as a result of this contact by the evening of Sept 23

On Sept 23, the third author arrived with five others All six had been inoculated intranasally at Aberdeen on Sept 19 with one of their "pedigree" virus strains from the Salisbury unit On arrival at the island, four of these subjects had already got colds In the other two, colds were doubtful, but they developed well later Details regarding the cold strains and regarding the experiments to study the routes of transfer of infection are adequately given Much to their surprise, no colds had developed in any of the 12 exposed "islanders" by Sept 29

After failure to obtain "takes" from exposure to induced colds, they conducted an experiment to compare the infectivity of natural and induced colds and adequate details are given of this experiment A natural "wild" cold did spread to three out of eight subjects

These results suggest that there is a difference between natural and artificial colds as regards infectivity Full exposure of eight previously isolated persons to 10 induced colds, both in their incubation and fully developed stages, failed to reveal one instance of natural "jumping" of infection, on the other hand, one natural cold, even though it had reached its fifth day, and was no longer active, induced colds in three out of eight persons after an exposure of only three and one-half hours

Louis Goldstein,[3] in a paper on cold weather as a factor in the epidemiology of grippe and the common cold, states that it is generally believed that one or more filtrable viruses are concerned in the etiology Exposure to viral agents, however, does not necessarily provoke the clinical syndrome of grippe or colds A lowering of resistance seems essential before enough damage is incurred by the respiratory epithelium to permit invasion by the pathogenic organisms

Prominent in numerous accounts of the origin of respiratory illness is the factor of exposure to severe cold This is first borne out by the seasonal variations in the occurrence of colds and other respiratory conditions Because of this the author decided to observe a large series of children and record his findings

The children were exposed in February and March Approximately eight to 12 days after any day of subzero temperature, there appeared a sharp and sustained increase in the number of cases of acute illness A second increase in the number of cases of acute illness was noted three to five days after each initial peak Each successive subzero day was associated with a subsequent increase in the number of sick children. Following final exposure to subzero weather, the incidence of acute illness gradually declined to endemic levels

Goldstein believes an interpretation of the data is offered in terms of anamnestic reactions substituting for clinical infection (The anamnestic reaction is a period of rapid production of large quantities of antibodies by a previously sensitized animal or person in response to minute antigenic stimuli) These are held to provoke the clinical syndrome of common colds cold equivalent or grippe as a manifestation of biochemical disequilibrium

Fletcher and Fletcher[4] think it surprising that little attention has been paid in Great Britain to the resistance that may be gained to the common cold and its complications by adequate quantities of ascorbic acid

They believe that no single figure for the daily requirement of ascorbic acid is likely to suit all individuals at all times

This is likely to vary according to circumstances, as does that of common salt Completely consistent results between various experiments, even though well-planned and controlled, are, therefore, not to be expected They mention various reports showing a favorable effect on resistance to infection with daily doses of 90 mg or more They believe that the results of adequate experiments would show that considerable benefits can arise from ascorbic acid treatment given in sufficient quantities at the right time

An experiment on the use of an antihistaminic drug for treatment of the common cold was carried out very successfully by Fisher[5] at a Summer camp for boys There were 260 boys between the ages and nine and 16 years at the camp, together with a staff of over 100

At the beginning of the season the campers were instructed to report for treatment at the earliest symptoms of a cold, because the chance of cure was greatest at that time One group was given tripelannamine (pyribenzamine) hydrochloride 50 mgm four times daily for boys 12 years old and over, and 25 mgm four times daily for boys under 12 years The other group was given a white lactose tablet four times daily Therapy was continued in each case for 48 hours, and if at that time symptoms still persisted, routine symptomatic therapy was started A good case record was kept for each patient

If a boy reported back a second time with a cold during the Summer, he was given treatment in the opposite group to his previous one Patients of known allergic nature were excluded from the test Those of unreliable or unstable personality were also excluded

As it happened, there were 37 cases in each group and the results were almost identical in each, there being 11 cured and 17 improved Side effects were few, as only four cases complained of drowsiness in the tripelannamine hydrochloride group, but there were also four cases of drowsiness among those given the placebo

The author concludes that from his study tripelannamine proved no more effective than a placebo in the treatment and prevention of the common cold in its early stage He also stated that the giving of medication for the common cold, be it placebo or tripelannamine, gave satisfaction to the majority of patients.

Tremble[6] correlates some of the known facts of ciliary movement in certain lower forms of animal life with those facts known about ciliary movement in humans. The marked variations in normal human nasal mucosa and submucosa in different areas and the distribution of cilia are described

In general it may be stated that the thickness of nasal mucous membrane is dependent upon the degree of impact and air flow over the surface. For instance, the exposed inactive anterior third of the septum and lateral wall has a thick membrane of 10 to 15 cells in depth, while the membrane in the active posterior two-thirds has a layer of only eight to 10 cells. In protected areas not influenced by direct air currents, such as the middle and inferior meatuses, the cells are four or five layers deep, and the membrane is thinnest of all in the sinuses, where the exchange of air is negligible. The mucosal lining of the sinuses consists of only two or three layers of short cuboidal cells and is often only a fraction of a millimeter in thickness Except for the ethmoid cells, the stroma is loosely attached to the sinuses.

In other words the more exposure to outside air laden with dust, smoke and fumes of all kinds, the thicker the epithelium, the less exposure to these influences, the thinner the membrane. The depth of the stroma containing the blood vessels is in proportion to the depth of the epithelial layer The stroma is widest in the exposed anterior position of the nose and disappears almost entirely in the sinuses

SINUSITIS

Tremble[7] has written a clear, concise resumé of the conservative treatment of sinusitis, a considerable portion of which deals with sinusitis in children He observes first that the signs and symptoms of acute and subacute sinusitis are so

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Walter C Price[8] discusses in two articles the recognition and treatment of sinobronchitis in children He defines sinobronchitis as "involvement of the sinus membranes by an infectious process of sufficient intensity to have implanted itself likewise upon the bronchial mucosa, either directly (by means of contiguous extension or postnasal secretion) or indirectly (by lymphatic spread)" The study concerned 384 patients admitted to hospital over a three-year period Roentgen examination was made of the chest and sinuses and 126 children showed evidence of sinobronchial disease Three classifications of degree of respiratory tract involvement were established the first class, or slight involvement, showed minimal thickening of the sinus membrane associated with prominent hilar nodes or faint increase in pulmonary markings, the second class, designated as moderate, showed definite membrane swelling and sinus opacity, together with accentuation of bronchovesicular markings, the third class, called advanced, showed opacity of the sinuses with sometimes polypoid changes, along with bronchopneumonia infiltration or lobar consolidation

The prevalence of sinobronchitis in the 126 children was presented in a table which showed 105 cases in the first class, 11 cases in the second class, and 10 cases in the third class Study by age groups showed the prevalence of sinobronchial infection was greatest in children under nine years of age, and moderate to advanced sinobronchitis was present more often in children five years of age or under

The writer of the article says acute sinobronchitis arises from bacterial infection of the respiratory tract epithelium, and there is a rapid spread of the inflammation to the mucosa of the sinuses and bronchial passages He describes the pathologic changes in the mucosa under three stages, according to the extent of the involvement.

In the second article, Price,[9] along with Veronica Binns, lays down a treatment program for chronic childhood sinobronchitis Three groups were formed and the patients were divided among these in the numbers of 16, 18 and 20, respectively, there being 54 cases in all

Treatment for Group 1 consisted of an antihistaminic drug (syrup of histadil) administered orally, and parenteral penicillin Group 2 treatment was the same as Group 1 with the addition of intranasal aerosol penicillin inhalations For Group 3 the treatment consisted of the antihistaminic drug, parenteral penicillin intranasal aerosol penicillin inhalations, and parendine penicillin nose drops (par-pen) The results obtained in Group 3 were uniformly better than the other two classes after treatment was carried out for about a week in most cases. Evaluation of the results was based upon changes in the Roentgenograms made on completion of therapy in comparison with those taken at the beginning of treatment The rationale of the combination of the above drugs is the elimination of the infectious process while simultaneously controlling the allergic response of the sinobronchial mucosa to bacterial protein Thus the hyperplasia of the membrane regresses permitting normal epithelium to regenerate

Edward E Brown,[10] in discussing rheumatic fever, says six pertinent observations must be explained and correlated The observations are *1* high incidence of preceding upper respiratory infections, *2* increased antistreptolysin titers prior to, and at the onset of the disease, *3* failure of tonsillectomy to prevent recurrences of rheumatic fever, *4* variety of organisms cultured in rheumatic fever, *5* geographical variations, and *6* seasonal variation in incidence He then proceeds to show that the etiologic agent is the hemolytic streptococcus, and that the focus is chronic sinusitis

Brown says that for the effective prophylactic and active treatment of rheumatic fever, infected sinuses should be drained This is accomplished as follows *1* Elevation of the head and avoidance of prolonged recumbency *2* Use of proper nose drops or a benzedrex inhaler twice daily, followed by hot wet towels to the face Ephedrine sulphate 1 per cent, in normal saline solution, tends to open the ostea of the sinuses, while moist heat to the face helps to drain purulent secretions under tension *3* Avoidance of chilling *4* Allergens should be sought and avoided, since they tend to produce congested sinuses *5* Fatigue should be avoided

The author claims that in man, chronic sinusitis is the only consistent focus for streptococcus toxins under pressure Rheumatic pains result when they are forced from the sinuses into the general circulation In his rheumatic fever patients he always notes the condition of the nasal sinuses and prescribes treatment for all who show activity Fever, pain, and other symptoms of rheumatic fever subsided rapidly Treatment of chronic sinusitis was continued indefinitely and was found to be an effective means of prophylaxis against rheumatic recurrences

ANTIBIOTICS

Davison[11] concludes that sensitivity cultures on blood agar are a useful means of determining which antibiotics should be used and the size of the dose necessary to promptly cure an infection He has noted that the gram positive cocci causing otolaryngologic infections have become relatively resistant to the action of penicillin Between 3,000,000 and 6,000,000 units may be required daily In severe infections he advises the use of streptomycin as well He feels that topical applications of antibiotics are of little value. Aureomycin and terramycin are effective as long as vomiting and diarrhea do not interfere with their absorption

Everett[12] reports two cases of anaphylactic reactions from the instillation of penicillin into the maxillary sinuses — these are probably the first due to local application Both patients over a period of years had received penicillin therapy without ill effects and were probably sensitized by repeated exposure

Wyngaarden and Seevers[13] have tabulated the common side effects of antihistaminic agents Most of these are innocuous and are important merely because they are annoying, however, in some patients the drugs are avoided because of the unpleasant severity of the side effects

Severe toxicity is rare, but serious reactions have resulted from idiosyncrasy or overdose. Eleven fatal cases were reviewed, in eight of which the patients were under the age of two Infants and children seem predisposed to the development of convulsions from overdosage and the mortality rate in infants when convulsions develop is high — adults tend to development of central nervous system depression which may on occasion be lethal

Agranulocytosis is another serious development which has been reported nine times, with one death

ALLERGY

Dill and Bolstad[14] report observations on 25 patients suffering from allergic rhinitis whom they treated by spraying the nose with a saline suspension of cortone acetate They were critical in their choice of cases two were children, 17 were men, and six women All had had nasal symptoms for many years, several had asthma 16 had nasal polypi, others had had polypectomies previously, 17 had been found sensitive on allergic studies. Each patient underwent a four hour period of observation in the clinic, during which time the nose was sprayed every half hour and detailed examination followed each application No general reactions were noted All patients experienced relief of nasal stuffiness and postnasal drainage They were re-examined after a 24-hour interval and all reported they were free of any irritation and had had no local or general symptoms The first few patients so treated were then given a quantity of the solution with instructions to spray each side of the nose four times a day at home and return for further clinical observation

Six case reports are given The child, age nine, two months after treatment was symptom-free In one adult numerous polypi in both nostrils disappeared during treatment but recurred when the spray was discontinued

It is the authors' impression that the use of cortisone nasal spray produces a temporary relief of the nasal symptoms of allergic rhinitis and they are continuing their experiment in the hope of gathering further data on the effects of the drug when used locally in the nose

Stromme[15] feels that a number of maxillary sinus infections are primarily allergic in origin with added secondary infection He feels that this aspect of the pathogenesis will be missed unless a very careful history is taken and all available diagnostic aids are used

He describes a method to determine eosinophilia in antral secretion and used this cytohistologic method on 78 outpatients with pus in the antral washings The method showed that 18 per cent had marked eosinophilia, and yet on first routine examination the presence of allergy was not suspected Further careful history and re-examination clarified the picture of allergic maxillary sinusitis with superimposed infection

TONSILS

Gale[16] states that there are few subjects on which opinions are more divided than on that of tonsillectomy He notes great variations in the prevalence of the operation in different parts of the country and proceeds to review certain statistical evidence, because such evidence is objective and is relevant to the consideration of the general indications and contraindications of operation It must always be remembered that all the statistical evidence in the world, however carefully compiled, will not solve the problem in the individual case Whether a child should have his tonsils out, and when, is a clinical and not a statistical problem Part of one of the reviews ended with the words 'One cannot avoid the conclusion that there is a tendency for the operation to be performed as a routine prophylactic ritual for no particular reason and with no particular result.'

He finds the following recommendations generally accepted

1. Tonsils should very rarely be removed before the age of five Adenoids should be removed at any age if they are causing nasal or Eustachian obstruction
2. The operation should not be performed on a child who has never had symptoms, whatever may be the appearance of the tonsils
3. Tonsils should be removed on account of frequent attacks of tonsillitis with fever
4. Tonsils should be removed at a suitable interval after a quinsy
5. Tonsils should be removed in the very rare instances when they are so large that they cause mechanical obstruction
6. Tonsils should be removed in chronic diphtheria carriers when other treatment has failed

The decision whether tonsillectomy is necessary or not is by no means an easy one and both the general practitioner and the laryngologist have a contribution to make to it The general practitioner knows how often the child has had tonsillitis and how ill he has been with it, and the laryngologist is in the best position to evaluate symptoms of nasal and Eustachian obstruction and to consider how far the child's symptoms may be due to a chronic sinusitis Generally speaking, it is better to delay decision than to hurry it and, above all to avoid operation on tonsils which have been recently inflamed

Gardner[17] comments upon that large group of potential subjects for tonsillectomy, young school children of five to seven years who suffer from recurrent upper respiratory infections If to these are applied conservative measures, one quickly learns what the natural history of the syndrome is — that it is usually self-limited, with a marked tendency to spontaneous cure at about seven to eight years, therefore, he believes that decision about operation on this group of young school children should be postponed as long as possible If this were done he believes many of these children would end by keeping their tonsils

Kershaw[18] states that observation that the syndrome of recurrent upper respiratory infections in school children is self-limiting is not new He believes it is possible to go even further and to say that investigation among younger children in nursery schools, nursery classes and day nurseries show that the phenomenon is independent of age and occurs at that point in a child's life at which he is first exposed to herd infection The process is, perhaps, rather physiological than pathological, and constitutes a stage on the road to immunological maturity

It seems not unreasonable to suggest that enlargement of the tonsils, like enlargement of lymphoid tissue elsewhere in the body, is a process secondary to infection in the appropriate drainage area Mere bigness of the tonsil ought to suggest that some primary cause should be sought and treated

Whittier[19] urges reassessment by the ear, nose and throat specialist before the operation is performed on children originally selected by him for tonsillectomy He frequently sees children who were scheduled for operation and who, two years later, though still awaiting this operation, have had little trouble from their tonsils in the meantime, and appear to have healthy tonsils at the time of his examination He feels that such a reassessment would result in many children having their names crossed off these long waiting lists

He believes it is not universally appreciated that the tonsil is not a static structure, but one that can increase or decrease in size without necessarily requiring interference. He is in agreement with the argument that simple enlargement of the tonsils is not a prime indication for tonsillectomy

A complaint often heard from parents of children in nursery schools is the frequency of colds, and tonsils have often been removed to prevent these colds. It is difficult to see how the removal of one of the defensive weapons of the body could raise resistance to a virus infection.

Hyde,[20] from a study of 1,000 patients plus a review of the literature, points out that there is a high percentage of tonsillectomized patients who are found to have tonsil remnants—68 per cent when removal is done by general practitioners and 64 per cent when the operation has been done by nose and throat specialists

The author points out that there are certain inherent factors which make tonsillectomy a difficult operation The exposure is limited by the size of the mouth — the fact that illumination can only come from one direction — the difficulty of hemostasis and the fact that the usual position of the patient allows blood to obscure the line of dissection

In his own practice the author has been able to reduce the incidence of "remnants" to 18 per cent — of which, only two of 48 were actually tonsil tissue, the remainder being lymphoid tissue without demonstrable crypts (giving a success percentage of 99 per cent)

He advocates the Davis type mouth gag for removal under general anesthesia and advises against the use of the snare

For removal under local anesthesia he positions the patient so that he sits with his head looking downwards and forwards so that the blood runs out of the mouth rather than down the patient s throat.

Reeves and Brill[21] suggest that no adenoidectomy be considered complete without the examination for removal of diseased or hypertrophied salpingonasal, salpingopalatine and salpingopharyngeal folds They state that the literature is replete with articles advising irradiation after adenoidectomy for destruction of the remaining or re-formed lymphoid tissue In their opinion many a radium treatment will not be necessary if we remove the hypertrophied folds during adenoidectomy It is not at all rare that a simple adenoidectomy does not relieve mouth breathing They found in 10 cases the enlargement of these folds was so big that removal was advisable The elimination of big masses of lymphoid accumulations in a place so openly exposed to bacteria will diminish the number of focal infections They describe a radical adenoidectomy under visual control

Wright and Pray[22] present a study of 1,648 tonsilloadenoidectomies The first 411 cases were used to study the effect of vitamin C upon secondary bleeding In the last 1,237 cases a study was made of the effect of elimination of acetyl salicylic acid on secondary bleeding Their conclusions are as follows Administration of vitamin C has no appreciable effect on secondary bleeding following tonsilloadenoidectomy Acetyl salicylic acid given after tonsillectomy increases the incidence of late secondary hemorrhage This is shown by the marked reduction in the incidence of secondary hemorrhage when acetyl salicylic acid is withheld This increased bleeding incidence from the use of acetyl salicylic acid may be due to its local effect in the mouth Vitamin K taken before and after the operation appears to have no antihemorrhagic effect

Belal[23] reports the accidental discovery, during routine microscopical examination of tonsils and adenoids, of bilharzial ova The patient was a male, 12 years old, whose adenoids were removed because of nasal obstruction and snoring at night The type could not be determined No cercarie or worms were observed Three photographs of sections accompany the report

Slater and Stephen[24] consider endotracheal intubation the ideal method of administering anesthesia for tonsillectomy and adenoidectomy For, today the anesthetist must be prepared to maintain an even, adequate plane of narcosis for from 30 minutes to more than an hour They consider it best to bring the child into hospital the afternoon before surgery and it is preferable for patients to be watched closely by the nursing and resident staff for 24 hours after operation Thus the child spends two nights in hospital At their hospital, the Children's Memorial Hospital in Montreal, it is the custom to give these children nembutal, morphine, and scopolamine one hour before going to the operating room (A table showing the dosage is provided) With this combination, patients are quiet and asleep when seen by the anesthetist and yet they will open their eyes and respond to questions A patient receiving these drugs requires careful watching before operation to insure that his airway does not become obstructed After operation the effect of the agent may persist for several hours and delay return of the active reflexes which aid so much in promoting a smooth convalescence The authors consider carefully certain complications of anesthesia, such as anoxia, hypoxia, reflex laryngospasm following extubation and anoxemia. They state that during the last four years in which more than 3,000 tonsillectomies and adenoidectomies were done there were no pulmonary abscesses and only one patient who developed bronchopneumonia.

[*Comment* The authors of this resumé do not agree that the above technique is the ideal one for this operation in children At the Hospital for Sick Children, Toronto, the number of these operations has been several times greater per annum and there have been no postoperative pulmonary abscesses for over 30 years The reason for this excellent record is considered to be prohibition of preliminary medication, short anesthesia, and attention to the child on the operating table after operation until the cough reflex has returned and the patient has vomited The operations are booked at half-hourly intervals.]

Barkash[23] mentions ways in which the physician can be helpful with the emotional aspects of his patient's health He feels that all that is needed is common sense, decency, sensitivity and intuition in handling of patients

Among other medical practices he criticizes the usual lack of preparation and explanation with regard to children undergoing tonsillectomy

He feels that considerable emotional trauma can be avoided if the physician explains to the child what is wrong and what the child is to expect when he enters hospital for the operation He feels the mother should be allowed to accompany the child right up to the moment of anesthesia and be there immediately upon awakening

Anderson and Faust[26] state that because cardiac standstill continues to be an ever present danger during general anesthesia, otolaryngologists should be able to institute some predetermined plan of treatment as soon as the diagnosis is made

Resuscitation efforts can preserve life and, as well, an undisturbed psyche in about one-third of the cases

Adequate therapy maintains circulation and oxygenation of blood until normal activity of heart and respiratory system is resumed Artificial circulation must be established in three and one-half minutes and cardiac massage is the most effective measure

A case of cardiac standstill after tonsillectomy under general anesthesia is presented

POLIOMYELITIS AND TONSILLECTOMY

Miller[27] presents an unusually careful study of 1,229 cases of poliomyelitis which occurred in Los Angeles County during the epidemic year of 1949 in an attempt to determine whether there is any relationship between a recent tonsillectomy and adenoidectomy operation and *1* the incidence of poliomyelitis and *2* the development of bulbar poliomyelitis, as well as in an attempt to determine whether *3* tonsillectomies and adenoidectomies should be discontinued during the Summer months of highest poliomyelitis incidence

The results of the statistical analysis indicate no clinical or statistical significant deviation between the actual and the expected incidence of poliomyelitis developing in Los Angeles County during 1949 in patients recently tonsillectomized and adenoidectomized even in the months of July through October

In view of these observations he believes that no reason was found to discontinue doing indicated tonsillectomies and adenoidectomies during the Summer months

This study impresses these reviewers as being admirably and thoroughly carried out. This impression was shared by four discussers of his presentation The discussions occupy three pages of fine print and are a valuable addition to the paper

Siegel, Greenberg and Magee, from the Bureau of Preventable Diseases, New York City Department of Health, made an extensive report on the relationship of tonsillectomy to poliomyelitis. This work is under two headings first, ' Studies on Incidence in 1949,"[28] and second, "Frequency of Bulbar Paralysis, 1944-1949 "[29]

In 1949, New York City experienced its third largest out break of poliomyelitis, there being 2 446 cases and 179 deaths. During the year, in a population of approximately 8,000,000, 53 007 tonsillectomies were performed during 1949 in New York City Hospitals, but very few of these were carried out during July August and September Although 74 cases of poliomyelitis occurred in recently tonsillectomized patients, only 50 cases were considered since these were operated upon in the New York City Hospitals where the total population at risk was known Even with this reduced number of cases, they still were able to conclude that in New York City in 1949 it appeared that tonsillectomy predisposed to the development of clinical symptoms of poliomyelitis

For the second part of their report, Siegel Greenberg and Magee took their 1949 statistics, but also went back to 1944 and included all the years between as well. Like 1949 in New York City, 1944 was also an epidemic year for poliomyelitis It was in 1944 that a query on recent tonsillectomy was carried out for the first time on the Health Department's poliomyelitis cards

In this survey there were 6,524 cases of poliomyelitis, of which 1,026 were the bulbar type. Among the reported cases a history of tonsillectomy within one year of the date of onset of the disease was given in 194. This latter number formed the basis of the study. These 194 cases were compared with a "matched group" as a control. They found that there is a predisposition of recently tonsillectomized cases of poliomyelitis to bulbar paralysis. The relationship seems firmly established for cases occurring within one month after operation and is most marked in the first three weeks or within the usual incubation period of poliomyelitis.

MOUTH AND THROAT INFECTIONS

Landsman, Grist, Black, McFarlane and Blair[30] present a carefully tabulated study of a properly controlled trial of 100 patients in ordinary urban practice who complained of "sore throat" as the leading symptom. The patients received tablets which, though differing in composition were similar in appearance. One set contained 0.5 gm. of sulfanilamide, another, 0.5 gm. of sulfatriad, and a third, 0.5 gm. of lactose. They have decided that the results of their therapeutic trial do not support the thesis that sulfonamides exact a beneficial effect in the treatment of the "acute throat." Those who place more faith in the virtue of clinical impressions will no doubt be unconvinced by an array of "statistics." It is well to remember that the average duration of fever and pain in those cases treated with lactose was exceedingly short — namely, 1.07 and 1.95 days, respectively. In view of this, added to the fact that in about half of the cases a streptococcal etiology is unlikely, it seems that to use drugs which have definite and known dangers is unnecessary, besides being expensive.

Macdonald and Watson[31] endeavored to find out whether sulfonamides were efficient and economically reasonable drugs to use in the treatment of acute throats in particular under Service conditions.

Eighty-two consecutive cases of acute tonsillitis were divided into two equal parts in a random manner. They were all treated by rest in bed and given copious fluids to drink. One-half were given 50 0.5 mg. tablets of sulfatriad. The other half received an equal number of lactose tablets identical in appearance to the former.

Analysis of clinical records revealed no difference between controls and treated cases in the speed of recovery from various symptoms The medical officer in clinical charge was, however, able to make an estimate of "goodness of cure" which had a significant relationship to administration of sulfatriad

The authors felt that the routine administration of sulfonamide to patients with acute tonsillitis cannot be supported by the results of this experiment.

The results of these two trials, says the *British Medical Journal,*[11] agree in failing to provide evidence that sulfonamides accelerate recovery from an acute sore throat. On the other hand, they do not decide whether this treatment is effective in preventing such complications of a streptococcal tonsillitis as otitis media or subsequent rheumatic fever, only one case of the former occurred in all the 182 patients considered in these two papers and rheumatic fever is mentioned in neither of them In a sense it is more important to protect a patient against these consequences than to accelerate recovery from an illness which is normally of very brief duration

In regard to cases of known streptococcal etiology, it is pertinent to inquire why drugs which are usually fully effective against the same organism elsewhere in the body should apparently fail to subdue it in the tonsil or the pharyngeal mucosa Is it that recovery from these infections is usually so rapid that a true underlying therapeutic effect cannot materially accelerate it? In tonsillitis, is it that the streptococci are multiplying chiefly in crypts where the drug cannot reach them, or owing to the nature of the medium cannot act upon them? Whatever the explanation, we must accept the fact that the immediate effect of sulfonamides on streptococcal throat infections has sometimes been overrated

Macleod[12] observes that general practitioners learn with surprise if not vexation that sulfonamides are valueless in acute tonsillar infections. Before the sulfonamide era acute tonsillitis was a severe illness with an acute phase lasting about a week. Untoward and common sequelae were acute otitis media and acute mastoiditis More remote and rare effects were rheumatic fever, arthritis, pleurisy and even malignant endocarditis Since the advent of the sulfonamide era the clinical picture has changed One to three days initiates the period of convalescence, and untoward effects are extremely rare During the same period scarlet fever has become a benign disease In the presulfonamide era he encountered on the average a peritonsillar abscess once weekly, while otitis media was not infrequent and acute mastoiditis not very rare During the sulfonamide era he encountered peritonsillar abscess once and acute mastoiditis once Until more observation is done and more data available he cannot believe that sulfonamide therapy is superfluous in acute tonsillitis

The clinical picture of vesicular pharyngitis is described by David, Leavitt and Howitt[34] as follows "The child, usually under five years of age, became ill suddenly with fever, malaise and anorexia Examination revealed vesicular or aphthous lesions on the soft palate and anterior faucial pillars The fever was of brief duration, usually less than 48 hours" Thirteen patients on whom studies were made during the Summer months of 1949 and 1950 showed a striking uniformity in their clinical picture A virus organism was isolated from the throat secretions of 12 of the 13 patients This organism was the coxsackie virus

The coxsackie virus has been isolated from patients ill in Summer months from such infections as paralytic and nonparalytic poliomyelitis, Summer grippe, encephalitis, epidemic pleurodynia and fever of unknown origin

Karelitz, King and Rubinstein,[35] working at the Willard Parker Hospital, proceeded to determine the clinical effect of aureomycin in cases of acute faucial diphtheria, and in diphtheria carriers Good results had been obtained with penicillin and antitoxin, but the C diphtheriae were becoming resistant to penicillin For this reason it was decided to try out aureomycin in a similar manner

Thirteen patients with faucial diphtheria, and 11 carriers, were treated with 25 to 50 mgm of aureomycin per kilo per day given in four equal doses. In addition, every case of acute diphtheria was given antitoxin as well, in appropriate doses. The acute cases averaged five days for negative cultures as compared to an average of 21 days in those cases receiving antitoxin alone, as shown by previous hospital records.

The carrier cases did not produce such good results on aureomycin Of these, two developed negative cultures in one day, one in two days, one in three days, and one in 10 days Four of the other cases were infected with nonvirulent strains of C diphtheriae These patients were discharged from hospital The other two cases were treated extensively and one cleared on dihydrostreptomycin C diphtheriae were not eliminated from the other carrier

The results here were satisfactory, and indicate the possibility of using aureomycin along with diphtheria antitoxin in cases of acute diphtheria, and alone in cases of diphtheria carriers

IRRADIATION

The clinical value of radium or Roentgen therapy of lymphoid hyperplasia of the nasopharynx has been established over a period of years in thousands of cases. The paper by Garland, Hill, Mottram and Sisson[34] discusses the relative advantages and disadvantages of X ray and radium therapy in the treatment of lymphoid hyperplasia of the nasopharynx that causes deafness and other allied auditory disturbances

They show that with Roentgen therapy the dosage throughout the whole nasopharynx is more homogeneous and efficient than with intranasal radium applicators They also show that the dose in the immediate proximity to radium applicators is 10 times the dose ordinarily regarded as reasonably safe for the treatment of nonmalignant conditions The maximum tissue dose required for cure when X-ray therapy is used is lower and consequently safer

[*Comment* The claims made in this article are in such disagreement with much previous work that they should not be accepted without very careful study]

Roentgen therapy in lymphadenosis and sinusitis in children is discussed by Harold Levy[37] He defines lymphadenosis as a condition characterized by chronically infected hyperplastic lymphoid tissue of the Eustachian tube, nasopharynx, pharynx, adenoid, tonsil, and cervical, retropharyngeal and perihilar glands He presents a 10-year follow-up of 349 cases

Children differ from adults in the abundance of lymphoid tissue in the nose and throat regions, which may swell during an acute infection and cause obstruction It is for this reason that upper respiratory infections in children are so often complicated by otitis media, acute sinusitis, cervical adenitis and bronchitis These regions may be treated successfully by radiation therapy, either alone or in conjunction with other procedures The indications for radiation therapy are

1 Lymphadenosis
  - *a* In the young child (under five years of age)
  - *b* In children of all age groups with Eustachian tube obstruction (as evidenced by diminution of hearing), or granular pharyngitis, chronic or recurrent cervical adenitis, etc

2 Sinusitis (subacute or chronic) where the usual therapeutic aids (penicillin, etc) have failed, but before surgery is contemplated

3 Lymphadenosis with or without sinusitis
  - *a* In the chronically ill child (cardiac, tubercular, etc)
  - *b* In the "nonallergic" asthmatic child

In treatment, the author has used relatively small doses of radiation and has carried on weekly treatments for five to 10 weeks, depending upon the severity of involvement and the clinical improvement Some patients show much greater shrinkage of lymphoid tissue than others He considers radiation therapy preferable to radium because it is easier to administer, there is no need for anesthetic, local or general, there is a more widespread effect and the dose may be more accurately calculated

No untoward effects were noted in the series of cases under discussion, but every safeguard must be utilized

The results obtained in the 349 cases showed 70 per cent good, 18 per cent fair, and 12 per cent poor

SURGERY

Owens[14] contributes a simply and clearly described and well illustrated operative technique for the correction of choanal atresia by the transpalatine approach, which is recommended and should be studied in the original

Although congenital occlusion of the posterior nares is an uncommon cause of asphyxial attacks in the newborn infant, it constitutes a real emergency when it does occur The choanal atresia may be unilateral or bilateral, and may be caused by bone or membrane. Nasal breathing is difficult in the unilateral case and impossible in the bilateral one

According to Medovy and Beckman,[39] the diagnosis of choanal atresia is made by watching the infant breathe, by the passage of a catheter through the nose, and by the instillation of lipiodol into the nose followed by Roentgen examination A newborn infant will try to breathe through the nose and this may give rise to blue-spells, particularly at feeding time if occlusion of the posterior nares is present.

A one-sided obstruction case may be left alone until the infant is older, but bilateral occlusion usually requires early attention An opening is made through the obstructing bone or membrane, and then the opening is dilated once or twice a week for awhile. This allows the infant to carry on well and to be fed properly

These cases of choanal atresia, as a cause of asphyxia in the newborn, are not common, but should be kept in mind The pathologist also should think of this cause when an autopsy is performed on a case of sudden asphyxia death

Beyer Blair and Lipscomb[40] state that the treatment of intranasal meningoceles has been far from successful Only three cases reported in the literature have ended in recovery

They report an intranasal meningocele in an infant 22 months of age Two photographs of radiograms illustrate the report A left transfrontal craniotomy was performed Near the anterior tip of the left frontal lobe a small stalk of arachnoid-like tissue was encountered, sutured and cut A dehiscence in the cribriform plate was easily palpated A free pericranial graft was placed to cover the sectioned end of the arachnoidal stalk and the bony dehiscence Fifty-one days after operation the patient was considered well

Lewin and Cairns[41] have written a usefully illustrated article on fractures of the sphenoidal sinus with cerebrospinal rhinorrhea It reviews their experience with 84 adults with cerebrospinal rhinorrhea following closed head injury This condition occurs also in children and consequently this most informative paper deserves the study of the readers of this resume

In a series of 84 cases of C S F rhinorrhea following closed head injury, a dural tear over the sphenoidal sinus was found in 11 (13 per cent) and was the only tear in relation to the paranasal sinuses in five (6 per cent)

The main clinical characteristics of these five cases was the profuseness of the rhinorrhea, due to the fact that the tear involved the overlying cisterna chiasmatica Another sign which may be helpful in diagnosis is the radiographic demonstration of air in the cisterna chiasmatica as in one of these cases

Neighborhood signs, such as evidence of damage to the hypothalamic region, optic chiasma, or carotid artery, were present in nearly half the sphenoid cases, but by themselves they do not necessarily indicate a fracture involving the sphenoid sinus The preservation of loss of sense of smell is likewise no clinical guide

Operative repair is urgently indicated The risk of spread of infection intracranially into the basal cisterns is appreciably higher than with fractures involving the other paranasal sinuses

Operative repair is difficult and requires a bifrontal flap, usually with division of the falx and sacrifice of one or both olfactory tracts. Three patients underwent successful dural repair and have since been followed for nearly four years There has been no further rhinorrhea or intracranial infection and all are well or working

Beatty[42] states that in cases where a cleft palate has been closed with good result the physician is often reluctant to have a tonsillectomy done, fearing a resultant speech defect—but when such a patient is suffering local or systemic complications from infection in tonsils or adenoids a tonsillectomy and adenoidectomy must be done regardless of the previous palate operation

He considers that if tonsillectomy is done in the usual way an unpleasant speech defect and difficulty in swallowing will develop in most of these cases because he thinks the natural contraction of the tonsillar fossa will cause shortening by contraction of the soft palate

The author advises delay until it is a proved necessity—preferably until the child is six or seven years old

He describes a plastic procedure after removal of the tonsils in which the uvula is partially removed and the palate actually extended by suturing the two palatoglossal muscles together for a short distance downwards

[*Comment* This is an interesting proposal but the results would have to be seen before it could be approved]

TUMORS.

Kerwin,[43] in reporting a case of juvenile nasopharyngeal angiofibroma in a white youth of 16 years of age, presents a concise review of the whole subject. This is valuable because it has been the privilege of very few men to see several of these interesting cases These tumors occur during the pubescent stage, usually at about 14 The word juvenile used in the descriptive title of this condition is incorrect, rather it should be called adolescent nasopharyngeal hemangiofibroma

It is a relatively rare tumor restricted apparently to adolescent males It regresses as maturity (20 to 25 years) is reached Epistaxis is the chief symptom and usually is serious Ligation of the carotid is of questionable benefit Secondary extirpation is almost impossible Radiation and hormone (androgen) therapy offer the best possibilities of control Large tumors producing deformity of skull (frog-face) are resected by electrocoagulation and remnants or recurrences are treated with interstitial irradiation and androgen The most conservative therapy is always employed because of the usual spontaneous regression of the tumor at maturity

Finermann[44] presents a study of juvenile nasopharyngeal fibroma in a 13-year-old girl This tumor is a benign, firm neoplasm found primarily in the nasopharynx of young adults Onset of the neoplastic growth always occurs during adolescence Spontaneous regression is said to occur frequently at sexual maturity or adulthood The girl whose case is presented had not reached the age at which such neoplasm may tend to regress spontaneously She had a prominent smooth, pink encapsulated mass behind the left tonsillar fossa, extending into the hypopharynx Elevation of the palate revealed the mass to be merely the apex of a pear-shaped tumor filling the entire nasopharynx The tip of the mass was removed for section and three capable pathologists independently were of the opinion that the structure was identical with that called juvenile nasopharyngeal fibroma Six weeks after X-ray therapy was initiated, the neoplasm had receded high into the epipharynx, the projection in the left side of the nose had receded and shrunken Symptomatically, too, much improvement was evident Six months after the child was first seen her improvement has continued The author intends to delay surgical excision as long as possible

Penha[45] reports from Portugal the successful treatment of a nasopharyngeal fibroma in a 12-year-old boy with the nettle Urtica membranacea This is a common plant used by the natives to stop bleeding The patient had his nasal fossa filled with a fibrous tumor having a smooth surface and bleeding easily, also, the right choana was filled with a pedunculated tumor and on the right cheek there was a hard tumor the size of a pigeon's egg As the patient's anemia was progressing without any response to the therapeutic measures, a blood transfusion was given Removal of the mass was unsuccessful owing to serious hemorrhage The tumor contained extensive areas of fibroblastic cells and abundant intercellular cement. X-ray treatment was without benefit. The anemia became progressively worse in spite of much therapy It was while forced to give transfusion daily that the author decided to give the diluted infusion and later the aqueous extract of the Urtica membranacea All the symptoms, hemorrhage, nasopharyngeal tumor and nodule of fibrous tissue in the cheek subsided The patient was allowed to go home approximately 11 months after his condition was first noticed Recently the patient has stopped the treatment without showing any after effects or recurrences

The author describes the characteristics of the plant and the preparation of the solutions he used. He implies that his report is only the beginning of an interesting study

Hirst and Charland[44] discuss lymphosarcoma of the tonsil and report on two cases, one of which was a child four months old Tonsillar lymphosarcoma is characterized by marked hypertrophy of one tonsil, which may be two or three times normal size. The tumor presents a dull hyperemic appearance with rounded contours and a nodular surface It is soft and cystlike, and often becomes ulcerated and bleeds easily In the differential diagnosis, infectious adenopathy and lymphatic diathesis must be considered in these conditions there is enlargement of lymph nodes of moderate degree, and they are not so progressive in their extension. In these conditions pain is much more pronounced

The patient was hospitalized on April 27 because of high temperature and a draining left ear and after treatment with sulfadiazine, myringotomy and X-ray therapy was discharged on May 5 During and subsequent to the aural infection, the anterior cervical lymph nodes were enlarged and there was slight enlargement of tonsils and adenoids On June 14 the patient had no ear or nose symptoms or increase in adenopathy or tonsillar enlargement On July 19, there was noted for the first time the mass in the right tonsil and an increase in the size of the right cervical nodes Adenotonsillectomy was postponed because the history suggested pertussis On Aug 9, the mass was much larger and not so hyperemic and the veins of the pharyngeal mucosa could be seen extending over the surface of the mass A punch biopsy specimen was taken It was the opinion of the pathologist that the probabilities pointed to lymphosarcoma The patient was then treated with intraoral and external X-ray therapy and on Aug 23, after having received half of the total irradiation, the mass was definitely smaller and not so hyperemic On Oct 6, the patient was readmitted to hospital for study, treatment and a tonsillectomy if condition permitted The chief complaints were sore throat, mouth breathing worse at night, weakness and extreme pallor The tonsillar mass seen Aug 14 had now apparently diappeared On Oct 6, blood cell count showed 2,580,000 red cells, with 48 per cent hemoglobin and 37,700 white cells Another blood cell count on Nov 13 showed 1 850,000 red cells with 26 per cent hemoglobin and 100,000 white cells In spite of blood transfusions the child died Nov 19 after a few peaks of temperature to 105° with a final diagnosis of acute lympholeucemia

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GRASSES AS FOREIGN BODIES IN THE BRONCHUS AND LUNG

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Grass is the name applied to any plant of the family of Poaceae. The family is a large one, and it includes all of the relatively few common cereals It is characterized by flowers borne in spikelets of bracts, called glumes

Incidence — Considering the ubiquity of grasses, and especially the fondness of children for playing with them, their occurrence as foreign bodies in the tracheobronchial tree is extremely rare Both medical literature and clinical experience support the foregoing statement as to rarity At the clinic, up to the present writing, there have been only seven cases of grasses as foreign bodies in the air and food passages [12] Of the seven cases of grasses, all were in the tracheobronchial tree. As to medical literature, there are a number of valid reasons why *every case* occurring is not represented in print, but making a reasonable allowance for such unpublished cases, there can be no question as to rarity Seydell[23] comments on this rariety in relation to the perforative type of grass head, and the clinical records above given show that the rarity applies to the lodging type in the tracheobronchial tree. Seydell found only nine cases of the perforative type in the literature To these he added one case encountered by himself, making a total of 10 cases of spontaneous extrusion of grasses Adding to these 10 cases the 18 additional cases of extrusion found in the literature and herewith presented in the following table (see Table 1) *makes a total of 28 of the* extrusive type of cases With the just mentioned seven cases of the lodged type, the total is only 35 cases of inspirated grasses as foreign bodies in the tracheobronchial tree

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TABLE 1

CASES OF INSPIRATED GRASS SPIKES EXTRUDED THROUGH THE THORACIC WALL

Reported by	Foreign Body	Sex—Age	Duration*	Result
Ayral[1]	Wild barley	M—13 yrs	25 days	Recovery
Deloriere and Balident[3]	Foxtail grass	F—5 yrs	15 days	Recovery
Foster[4]	Millet grass	? ?	Approximately 12 days	Recovery
Johnson[16]	Barley grain'	F—2 yrs	About a week	Recovery
Knapp[17]	Grain spike'	? 8 mos	About 3 weeks	Recovery
Martin[19]	Spike (Barley?)	F—14 yrs	6 weeks	Recovery
Purcell[20]	Head of grain	F—4 yrs	29 days	Recovery
Resch[21]	Ear of grain (Kornähre)	F—9 mos	10 days	Recovery
Ricciolli[22]	An oat' (Spikelet)	M—15 yrs	? ?	Recovery
Schubert[23]	Cereal spike	M—9 yrs	9 days	Recovery
Sehring and Shaw[24]	Spike, Foxtail grass	M—4 yrs	14 days	Recovery
Carrière[17a]	Grass spike	M	18 days	Recovery
Destranges[17a]	Grass spike	3 or 4 yrs	6 weeks	Recovery
Labath[17a]	Grass spike	F—16 yrs	7 days	Recovery
Le Boeuff[17a]	Grass spike			Recovery
Pincent[17a]	Rye spike	1 yr	24 days	Recovery
Vigla[17a]	Grass spike	F—1 yr	3 or 4 wks	Recovery

*Duration refers to the elapsed time between the inspiration and the extrusion of the foreign body as nearly as could be determined from the report.

Etiology and Prophylaxis — As with most other cases of exogenous foreign bodies in deeper air passages, accidental inspiration of parts of grasses is due to putting inedible substances in the mouth In adults this is carelessness on the part of the patient In case of older children it is usually carelessness on the part of parents in not teaching children the dangers of putting small inedible substances in the mouth In case of babies and very young children carelessness in allowing parts of grasses and especially spikes of grass to be within reach They should not be allowed to play or crawl on the floor until such objects, or any other small objects, have been swept away or otherwise removed If a baby is to be placed on the lawn, a large sheet should be spread for him to play on and even then he should be watched Games and other play with grass spikes should be forbidden

PATHOLOGY

Clinical evidence indicates that there are two types of pathologic progress in cases of grass spikes occurring as foreign bodies in the tracheobronchial tree Seydell suggested that grass heads have the "power of spontaneous self propulsion" In the discussion that followed, Clerf[3] stated that he had not seen a case of spontaneous perforation by a grass head, but that in a number of cases of timothy grass head there seemed to be no tendency to perforation. All were removed bronchoscopically This is also the experience of the clinic Though the total number of cases of parts of grasses reported as foreign bodies in the deeper air passages is small (35 found in literature) pathologic progress and the clinical features justify the postulate that there are two distinct classes of cases One class may be appropriately called the *lodging type* and the other the *one way travel type* Clarity of presentation seems to call for a summary of the well known clinical facts relative to one-way travel of pointed foreign body toward the periphery of the lung, and for a discussion of the new problem of the botanical features of different grass spikes of the same genera as those that have been reported as having been extruded through the thoracic wall

LODGING TYPE OF GRASS SPIKE AS A BRONCHIAL FOREIGN BODY

The timothy spike is typical of the lodging type. No case of spontaneous perforation by timothy spike has been found in the available literature The seven cases of this lodging type reported[12] presented definite characteristics which may be summarized as follows

1 In all cases the foreign body was a spike (panicle) or part of a spike of timothy grass *(Phleum pratense)*

2 All of the patients were children, the respective ages were eight, 11, 20 months, three, six, nine, 14 years

3 Right bronchial tree, five cases, left, two cases

4 Duration of sojourn of timothy spike in bronchial tree before bronchial removal, eight, eight, 21, 25 days, three and one-half, nine months

5 Pathologic conditions were as follows vegetal bronchitis, tight bronchial obstruction to ventilation and drainage, suppuration, intermittent bringing up of pus accumulated in drowned-lung area

6 Pus of foul odor in long-sojourn cases

7 The symptoms were irregular fever, weight loss or failure to gain weight and to grow, cough, bringing copious amounts of usually foul pus, at intervals

8 Diagnosis was by bronchoscopy and removal of the foreign body Bronchoscopy was clearly indicated by the drowned lung In the case of the 20 months old baby there was a clear statement of the parents that the first coughing attack was when the then 11 months old baby was crawling on the floor This always implies a tentative diagnosis of foreign body, but in this case it was ignored for nine months, while the baby was treated for pneumonia, tuberculosis and thymic tracheal compression

9 The timothy spike presented itself to bronchoscopic view in six cases, a small fragment of a spike was hidden out of sight in one case In no case did a cylindric part of a spike of timothy make enough travel toward the periphery to disappear from the bronchoscopically visible lumen

10 Treatment —In all the cases the timothy spike was removed bronchoscopically All patients recovered perfect health generally as well as locally in the bronchial tree

11 The *prognosis* of the lodging type of grass spike apparently is good There was no mortality or serious complication in any of the seven cases The recovery, general and local in the lung, was complete This was remarkable in some of the cases, for example, the 20 months old baby, who for nine months had a timothy spike *(Phleum pratense)*, 3 3 cm long by 0 5 mm thick, in the tracheobronchial tree, with copious bringing up of foul pus from the area of the drowned lung The recovery after bronchoscopic removal was prompt

ONE-WAY TRAVEL TYPE OF GRASS SPIKE AS A BRONCHIAL FOREIGN BODY

Pathologic Postulates — Autopsic data are lacking The only death reported was from bilateral pulmonary tuberculosis, which was evidently in an advanced stage prior to the inspiration of "an ear of wild oats." Though the cases of perforative grass spikes are rare, sufficient clinical evidence has now been accumulated to justify certain postulates Clinical case reports demonstrate the fact that spikes of certain grasses when inspirated into the tracheobronchial tree can be forced on through the bronchial tree, pleural layers, intercostal tissue, dermal layers and be thus extruded In most of the cases there was no empyema and no pneumothorax, these two clinical facts justify the postulate that a preparatory adhesive pleuritis had sealed the visceral and parietal layers of the pleura together at the site of subsequent perforation These and other features indicate that these cases differ from cases of pulmonary abscess discharging into the pleural cavity and followed by chronic intercostal fistula. In typical cases so far as can be determined from the reports there was no large pulmonary abscess formation, nor prolonged suppuration The passage was rapid, ranging from eight to 29 days in children no chronic suppurative track remained in the lung Though bronchoscopies are not reported to have been done subsequent to the extrusion of the grass spike, the reports of prompt healing and recovery of perfect health imply that there were no suppurative or bronchiectatic sequelae There seems to have been prompt healing of the entire track of transit in the wake of the one-way travel This is supported by the evidence in the one case in which bronchoscopy was done during the one-way travel of a spike of grass (see under Bronchoscopic Appearances) In two of the exceptional cases it seems that there was residual suppuration due to operative opening into the pleural cavity by an ill-advised enlargement of the extrusive orifice to improve drainage of a supposed pulmonary abscess, which was evidently only an area of drowned lung, such as cleared promptly in other cases after extrusion

Mechanism of One-Way Travel of Foreign Bodies in the Bronchi. — The ratchet-like, one-way travel of foreign bodies in the bronchi was first noted in relation to pins (Jackson, 1915[5]) A number of illustrative cases were reported (Jackson and Jackson[8]), in which the pin had been worked downward by the ratchet-like action of the respiratory and tussive elongation and diametric luminal enlargement, followed by shortening and diametric diminution of the bronchial lumen In some of the cases the head of the pin "outdented" the visceral pleura Again, in writing of staples,[11] the same authors state, "Their branches, in most instances, diverge at a small angle, directing the points toward the walls of the invaded passage The shape of the foreign body (small rounded head and divergent pointed extremities) favors working deeper and deeper into the tracheobronchial tree by a ratchet-like action Under the enlargement and diminution of lumen, and elongation and shortening of the bronchi at each respiratory cycle and at each cough, the head slips down easily, but upward movement of the foreign body is prevented by the points sticking into the bronchial wall, the result is that the foreign body is forced down into the smallest bronchus it can enter "

In this one-way travel, as in all other phases of bronchial obstruction, the laws of physics apply As stated by Jackson,[14] "Movement relates the bronchi to that part of science known as mechanics, which treats of the action of forces on bodies, solid, liquid and gaseous So long as the bronchi contain only gaseous bodies they are concerned with the laws of pneumatics When they contain liquid bodies they are concerned with the laws of hydrostatics and hydrodynamics The presence of solids brings into consideration the fundamentals of mechanics in its restricted sense " One of these fundamental laws is that when sufficient force is applied to a movable solid body, the body moves in the direction of least resistance For example, a schooner close hauled does not blow off to leeward because of great lateral resistance of the hull It moves in the direction of least resistance, which is within about four points (45 degrees) of the direction of the wind, thus reaching a point to windward Conforming to the same law of physics, a foreign body whose points, by engaging in the bronchial wall, stop retrograde movements, moves *in the direction of least resistance* This, in the lung, is peripheral

The foregoing now generally accepted clinical facts explain the mechanism of one-way travel It remains to determine the nature of the greater penetrating forces manifested by certain grasses *In considering the penetrative one-way travel* of certain grass spikes, it is a primary essential to study the botanical structure of the grass spikes of the same genera as those of grass spikes reported to have made the one-way transit and extrusion

One difficulty encountered in the study of the botanical structure of the particular penetrative grass spikes is that, unfortunately most of the case reports of grasses do not identify the foreign body When the botanical classification is recorded study is simple For example, Larget, Maurice and Lamare identify the foreign body in their case report as a head of grass, *Trisetum flavescens* This is the type species of the genus *Trisetum*. The name is from the Latin *tri*, three, and *setum*, bristle, alluding to the awn and the two teeth of the lemma These three bristles are the important factors to be considered in the mechanism of one-way travel as discussed in subsequent paragraphs

The reports of more than half the cases give no details sufficient to classify the foreign body For example, "a head of grass," "head of common grass," "head of wild grass" As there are many genera and hundreds of species of grasses, indigenous and imported, in various countries of world, classification from such names is impossible, moreover, common names are often applied to a number of different genera even in the same locality Only one case report gives the botanical name of the foreign body, *Trisetum flavescens*, as just mentioned Of the others, some of the common names given can be classified with some degree of accuracy as to genera if not as to species, from names given in the case reports These are as follows "ear of barley, 3 cases, "spike of wild barley", "head of rye", "wild oats", "head of Foxtail grass," two cases, "millet grass", "an oat" (spikelet?), timothy "Cereal spike" and "head of grain" may have been any of the cereal grasses herewith illustrated or other less common genera

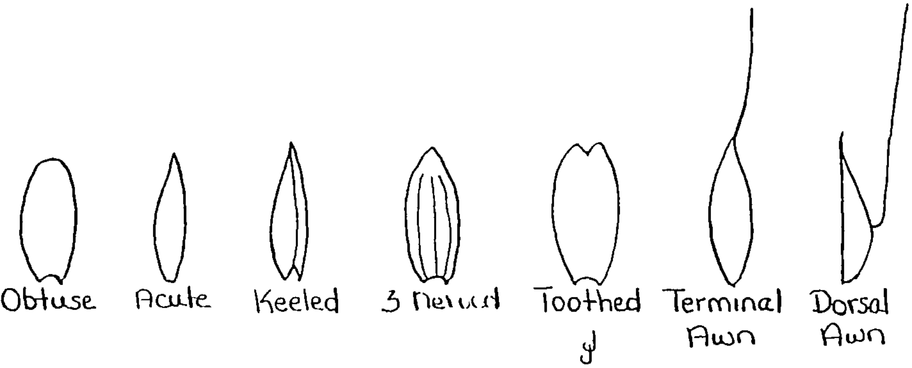

Fig 1 Sketches of the botanical features of spikes and spikelets of grasses *germane to the subject of grasses as foreign bodies in the bronchial* tree The glumes are attached at the base they extend upward and diverge slightly outward The upper free end may be obtuse or acute toothed or awned. The lower of the two glumes enclosing the flower is called the lemma. An awn is a bristle-like projection from a glume and collectively is commonly called a beard Glumes and awns point upward in growth when inspirated into the tracheobronchial tree the points trail The glumes lem*mas and awns are the pawls in the ratchet-like mechanism of one-way travel* and perforation of the thoracic wall by certain grass spikes.

For clarity of presentation of the subject of the mechanism of one-way travel, penetration, perforation and extrusion of grass spikes, it seems best to select from the foregoing list the genera that best illustrate the subject For this purpose an illustration of a fair average normal spike of the respective genera obviously is better than a photograph of the specimens removed, because the latter are incomplete and are the worse for wear in being forced through tissue, moreover, only a few of the specimens are illustrated in the reports The illustrations that have been published, however, have been carefully checked in comparison with the botanical sketches herewith reproduced (see Figs 1 to 6)

The natural function of the grass spike is to produce flowers, expose them to shaking in the wind for pollenization, produce seed and protect it to maturity The seed loosens and drops out The remaining parts of the spike hold together in their natural places for a time, retaining the form of a spike. They are sketched separately in Fig 1 No mention of seed is made in the case reports. In one case there is mention of a 'green head of barley" It may have contained immature seed

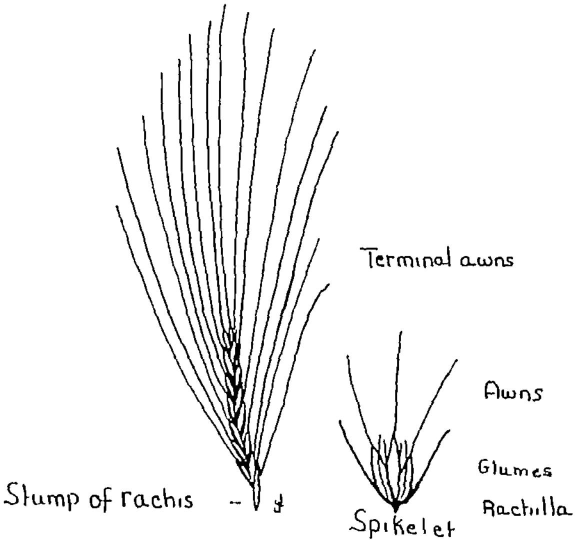

Fig 2 Sketch of an average spike and spikelet of cultivated barley (Hordeum vulgare) Length, - to 10 cm. exclusive of awns glumes divergent tapering into a stout awn awn of lemma straight, 10 to 15 cm. long. Barley spike reported as perforating in four cases. No case of lodgment appears among the cases found in the literature.

From the viewpoint of the physicist the subject of the one-way travel perforation and extrusion of certain grass spikes naturally falls under three heads, namely *1* the stops against retrograde travel, *2* the source of power, *3* mechanisms applying the power to the work

The Ratchet-like Stops Against Retrograde Travel of Certain Grass Spikes —It seems certain that a detached grass spike, or part of one, or a spikelet, when it enters the tracheobronchial tree, must enter and travel with the stub of the rachis (or rachilla in case of a spikelet) leading and the glumes and awns trailing (see Figs 1 and 2) This postulate is supported by *a* the mass of clinical evidence of the fact that practically all pointed foreign bodies, such as bar-pins, open safety-pins and staples, enter the tree and travel with the point or points trailing, *b* the appearance of the few illustrations of specimens of perforative extruded grass spikes

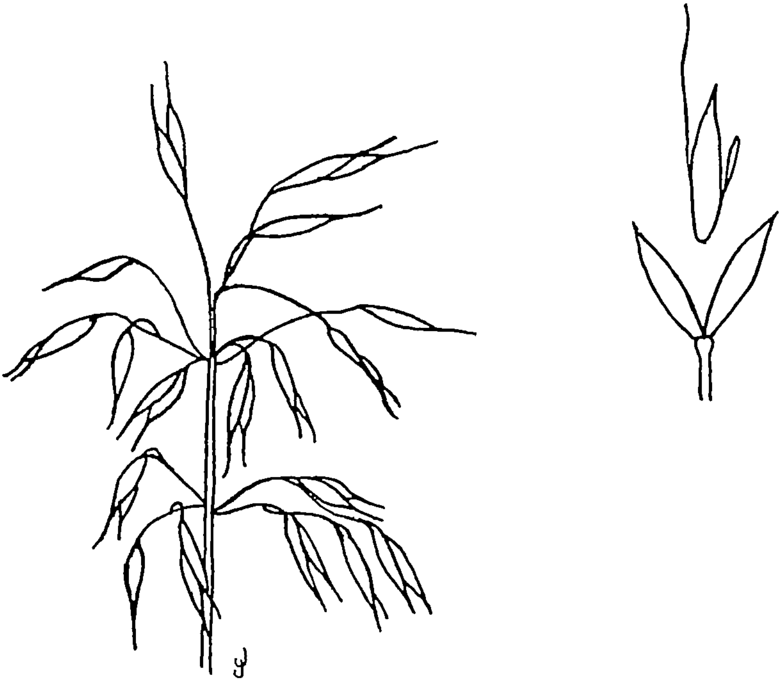

Fig 3 Sketch of panicle and of spikelet (enlarged) of cultivated oats *Avena sativa* Spikelets are large and suspended in a spike-like panicle, glumes about 2 cm long lemma bidentate awns straight and stout rarely wanting Report of perforation by an oat (spikelet) in one case

that have accompanied case reports, *c* a study of the structure of average grass spikes of the same genera and species as those reported as having perforated the chest wall (see Figs 2 to 6) will convince anyone that the stops against retrograde travel of such grass spikes in a bronchial tube, or in tissue, would be the upward divergent glumes and awns and that these would trail, *d.* palpation of any one of these grass spikes gives through the sense of touch unequivocal

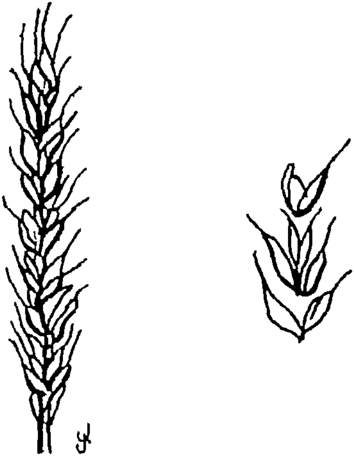

Fig 4 Sketch of spike and spikelet (enlarged) of wheat (*Triticum aestivum* or allied species) Spike 5 to 12 cm. long. Spikelets placed flatwise glumes rigid, keeled, apex abruptly mucronate or toothed or with one to several awns lemmas broad, keeled asymetric, abruptly pointed or awned. In the beardless wheat the awns are short and in some, spikelets wanting but the spikes are not entirely awnless. Probably some of the four perforating foreign bodies reported as "head of grain "cereal grain, cereal spike" grain spike" were a spikelet or part of a spike of wheat.

evidence of the stopping efficiency of the glumes and awns, *e* obviously therefore if any adequate moving force is applied to such a foreign body, it must conform to the laws of physics and move in the direction of least resistance like a close-hauled schooner, as before mentioned.

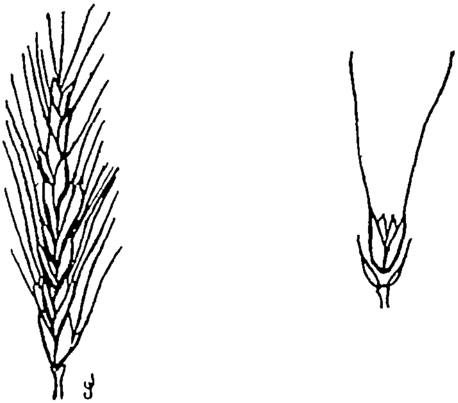

Fig 5 Sketch of spike and spikelet of rye (Type species *Secale cereale*) Spikelets are placed flatwise against the rachis glumes narrow rigid pointed lemmas broader sharply keeled ciliate on the keel and exposed margins tapering into a long resilient awn A head of rye has been reported as a perforating foreign body in one case and probably was also the foreign body in one or more of the cases of head of grain cereal grain cereal spike grain spike

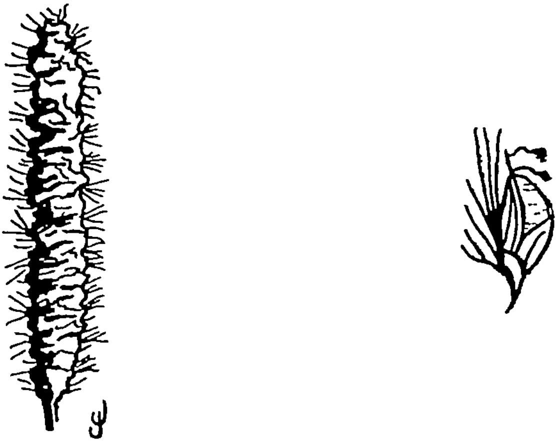

Fig 6 Sketch of spike and floret of the type species of foxtail grasses, *Alopecurus pratensis* meadow foxtail. The name of the genus is from the Greek alopex fox and oura tail alluding to the cylindric bristly panicle There are 10 species classified botanically but they vary little from the type species in the structural features that relate to one-way travel and perforation Panicle 3 to 7 cm. long 7 to 10 mm thick glumes 5 mm. long villous on the keel and pubescent on the sides awns exserted 2 to 5 mm Foxtail grass is reported as the foreign body in two cases of perforation and extrusion through the chest wall

In the bronchi the direction of least resistance is, obviously, peripheral When bronchiolar and parenchymal tissues are reached, a point of least resistance is created by suppuration in advance of the rhythmic prodding of the rachis. This is evident from the clinical fact that suppuration precedes extrusion of the grass spike through the skin. It is only a

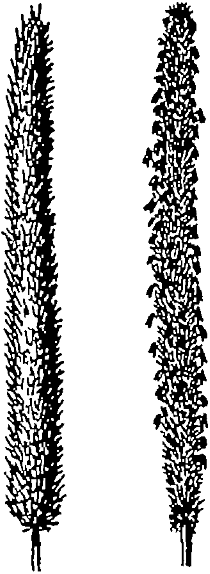

Fig 7 Sketch of an average spike like panicle of timothy grass (*Phleum pratense*) Panicle cylindric 5 to 10 cm. long sometimes longer the spikelet small crowded, spreading; glumes equal, membranaceous, one, sometimes 3 mm. long truncate, awn 1 mm. long sometimes absent pectinate or ciliate on the keel. Empty glumes awn pointed. These glumes, lemmas and short awns are relatively soft and lack resiliency when wet. At the right is shown a timothy panicle in full bloom. The rough appearance is due to the stamens which dangle in the wind for pollenization. They are soft and could not be concerned in stopping retrograde travel, nor much in mechanical irritation Allergic reaction a possibility Seven cases of timothy spike are reported as foreign body lodged in the bronchial tree None perforated. All were removed bronchoscopically[13]

small suppurative area that promptly heals after its task of creating a point of least resistance is completed It should be emphasized that this suppurative track is not pulmonary abscess The emphasis is important clinically to avoid ill-advised surgery at the site of extrusion

Bronchoscopists who do foreign body work will recall frequent experiences with two phases of endoscopic images that are germane to the consideration of one-way travel of grass spikes and spikelets, namely *1* bronchial movements, *2* behavior of foreign bodies under force of respiratory and tussive movements

The bronchoscopist has seen the fence staple slip away deeper and deeper in the bronchial tree, because of the visible ratchet-like stopping by the upward projecting points of the staple serving as a pawl by sticking into the bronchial wall He will, therefore, easily visualize the powerful and direct resistance to retrograde travel afforded by the many upward and divergently projecting points of glumes and awns of perforating grass spikes

THE SOURCE OF POWER FORCING TRAVEL OF GRASS SPIKES OR SPIKELETS

There is a tradition in some European communities that grass spikes have a mysterious power of movement One source of this belief is probably the entertaining trick of laying a spikelet of *Avena sterilis* (one of the species of "wild oats") on a plate and, after a prelude of patter "the touch of the magic wand" is used to "bring the spikelet to life" The contortions simulate the struggles of a living insect The secret is that this species of the genus *Avena* has twisted awns and when the spikelet is moved by the wand onto a wet place previously arranged on the plate, the absorption of moisture causes the awns to jerk and move weirdly in untwisting Taking this trick seriously, it may be said that it could not be considered as evidence of a source of power for perforative extrusion of a foreign body for four reasons *a* the movement of untwisting ceases in a few minutes, whereas the shortest recorded period required for travel and extrusion is seven days, *b* the untwisting of the awns is not a propulsive movement, *c.* no case of extrusive perforation due to *Avena sterilis* has been published, *d* none of the genera identified in the published case reports of perforative grass spikes have twisted awns

Another tradition that may have helped to create the belief that grass spikes have a mysterious power of movement is the common saying among English country boys to the effect that "barley grass heads will crawl.' The knowing boys put the spike upside down under the wristband of the shirt, and it progresses upward and arrives at the shoulder[26] Deloriere and Balident[3] mention the same kind of play as customary among the children of Picardie, using the spike of foxtail grass

Palpation of any of the grass spikes of the same genera as those reported to have been extruded through the chest wall reveals a remarkable degree of compressibility and resiliency of the spike as a whole It has been suggested that this springiness could be the power that causes the grass spikes to perforate the chest wall The springiness is due to the spikelets, especially the glumes and awns, however, neither the awns nor any other part of a grass spike generates any power

From the point of view of the physicist a spring generates no power it simply delivers the power that has been stored in it from some source of power

The *source of all the power* that drives the grass spikes through the bronchi, pulmonary parenchyma, adherent pleural layers intercostal and subcutaneous tissues is muscular It comes not merely from the bronchial muscles, but also from that powerful group of muscles whose action is synchronized by the autonomic nervous system in the operation of the respiratory bellows. Working at the average rate of, say, 20 cycles per minute throughout the 24 hours, with additional and even more powerful tussive cycles, it is no wonder that a spike can be driven through in as short a period as eight days, in some cases.

MECHANISMS APPLYING THE POWER TO THE WORK

In the application of this power to the work of driving the spike or spikelet through the bronchopulmonary and intercostal tissues, five mechanisms are concerned

1 *Tussive Squeeze* —An important part of the mechanism in the application of the power to the work of driving the perforating grass spike through the lung, on the way to extrusion is the tussive squeeze[9] The powerful muscular compression in the creation of the bechic blast far exceeds that of the partially passive diminution of the expiratory phase of the respiratory cycle Physiologically, this powerful squeeze forces secretions and exudates up from the periphery to the larger bronchi where the bechic blast can blow it out If a grass spike, in the right lower lobe, for example, were not stopped by the spikelets, glumes and awns, the powerful squeeze would force it up also, but the spike being stopped, the lobar tissues are forced up against the stub of the rachis, which is thus caused to penetrate the tissues This action can be better understood by an experience of my childhood I was playing with a soft, old-fashioned pin cushion that had no pins sticking in it In carrying it, I squeezed it with my hand and the point of a needle emerged through the fabric and stuck in my hand The needle had evidently, at some previous time, been pushed into the cushion until the blunt, eye end was under the containing fabric Then it travelled one way in course of handling of the pin cushion, as needles do in living tissues by force of muscular movements This well known one-way needle travel in tissue by force of muscular movements is illustrative of the perforation of a grass spike through the chest wall The "case" of the pin cushion illustrates the forcing of the grass spike through the smaller bronchi and pulmonary parenchyma by the mechanism of the tussive squeeze

2 *The Bechic Blast* —The blast of air itself exerts no penetrative power on the grass spike, but the greatest power in driving the grass spike through the lung and thoracic wall is exerted by the powerful contractive pressure of the chest wall, as it is forcibly compressed in creating the bechic blast

The mechanical principle involved is similar to the "case" of the pincushion mentioned It is also similar to that of the seamstress pushing the fabric over the needle which is stopped against retrogression by the thimble

3 *The Stub of the Rachis as a Perforating Tool*—Some of the reports of cases have photographic halftone illustrations of the foreign body specimens These illustrations all show a sharp end of the stub of the rachis (or rachilla in case of a spikelet) Most of the grass spikes found detached under natural conditions on farms have a sharp stub, not often sharply pointed, but sharp on palpation. Many stubs have multiple points of fracture that could introduce infection The relatively small diameter of the end of the stub of most grass spikes would permit entrance into a bronchus 1 mm in diameter with little force. It may be postulated that the stub of the rachis is the perforating tool It seems possible that if a staple had a pointed instead of a rounded head it might travel deeper than it does

4 *The Spring Mechanism of the Spikelets Glumes and the Awns* — The resiliency of the spikelets glumes and awns noted on palpation has been mentioned Though this resiliency generates no power, it may be postulated that power is stored in these springy parts of the perforative grass spikes, from the compression of the expiratory diametric diminution of lumen, and to a much greater degree during the powerful compression of the tussive squeeze

The bronchoscopist will have a mental conception of the appearance of, *a* a forcing of the grass spikes in the direction of least resistance by compression, *b* a compression of the resilient awns, and *c* followed by a springing deeper of the whole foreign body as the compressed awns are released simultaneously with the inspiratory elongation and diametric enlargement of lumen ahead

5 *Post Tussive Inspiration*—Another mechanism by which the thoracic muscular power is applied to forcing the one-way travel of the grass spike in the tracheobronchial tree is synchronous with the tussive squeeze This mechanism is the

deep inspiration that always follows cough It is preparatory to another cough, in case of a paroxysm The bronchoscopist, doing bronchoscopy without suppression of the cough reflex, is quite familiar with the remarkable luminal dilation of this *postbechic or intertussive deep inspiration* The area of cross-section is more than doubled Most foreign bodies advance toward the periphery during this extraordinary luminal dilation, accompanied as it is by the inrush of inspiratory air Gravity helps but little, if at all, in case of a grass spike

6 *The Prodding of the Stub of the Rachis*—Another important mechanism in application of thoracic power to the forcing of one-way travel of grass spikes is the prodding of the stub of the rachis (or the rachilla in case of a spikelet) The bronchoscopist from his abundant accumulation of moving endobronchial images is familiar with the rhythmic expiratory compression of the right lower lobe, for example This compression is, of course, accompanied by firming and diminution in size of the lobe and by shortening of the invaded lower lobe bronchus With a grass spike firmly fixed against retrograde travel in this bronchus, the perforating sharp leading point of the spike (stub of the rachis) and the tissue come together According to the physical laws of mechanics they could not do otherwise This movement is rhythmic prodding of the tissues by a perforating point, and is necessarily followed by a progressive advance in the position of the grass spike This prodding and the progressive advance of the grass spike are much more forcibly exerted and greatly accelerated at intervals by the tussive squeeze[9]

For clarity the penetration of the lung is used for illustration When the pleura is approached the inflammatory reaction in advance of the prodding of the rachis seals together the two layers of the pleura These and the aponeurosis, intercostal muscle and subcutaneous tissues are perforated by the prodding of the rachis, carried on by the movement of the thoracic muscles, just as muscular movement forces a needle to travel through tissue The only pathologic difference is that the needle is subject to ionization which keeps it relatively sterile, whereas the stub of the rachis carries on a limited area of infective suppuration which creates a point of least resistance in advance of its arrival. This is probably because the stub of the rachis is not as good a perforating tool as a pointed needle

In the *calculation of the efficiency* of the just mentioned mechanisms of application of the thoracic muscular power to the work of driving the perforative grass spike, full count must be taken of the *frequency of the application of the power* For illustration, respiratory cycles may be rated at 20 per minute Calculating 1,440 minutes in the 24 hours we have 28,000 daily applications of the power relative to respiratory cycles The powerful tussive squeeze is an additional and an enormously greater application of power, but it is variable and difficult to estimate as to its frequency It certainly is frequently applied during the one-way travel of a grass spike.

Failure of Timothy Spikes to Perforate — Although spikes and spikelets of grasses are peculiarly the kind of foreign body recorded as perforating from a bronchus to the dermal surface of the thorax, it is noteworthy that timothy spikes (panicles) have not been recorded as perforating, though they are recorded in the literature in seven cases, which is a greater number than any other genus of grass mentioned by name[12]

Speaking of timothy heads, Clerf[3] stated, "These were all removed from the bronchi Timothy heads have small barbs and their propulsive movement seems to be lost as soon as the smaller bronchi are entered" Our experience at the clinic coincides with that of Clerf

As before mentioned, a search of the literature reveals no case of spontaneous perforation by a timothy spike-like panicle In one of the clinic cases a small part of a timothy spike had reached a segmental branch of 2 mm luminal diameter but it was found bronchoscopically and removed It was the small size of the fragment that explained its reaching a segmental branch.[12]

Botanical examination of a timothy panicle under magnification when dry and also when thoroughly moistened, yields ample mechanical reasons fully to explain the clinical fact that they have not been recorded as having been driven through the lung in the way that certain other grasses have been driven They are worked peripherally as far as the smallest bronchus that will accommodate them without trauma, but no farther The average timothy spike-like panicle and its spikelets do not have the structure for the efficient pawl-like action for conversion of reciprocative movements into one-way travel

The spikelets of timothy are crowded tightly together into a spike-like panicle (see Fig 7) The glumes, flowering and empty, are translucent, membranaceous, small, short, thin, weak, they are acute and end in an awn-like point about 1 mm long, not bristly, and sometimes absent (see Fig 7)

Palpatory stroking of an average timothy spike when dry yields a sensation of slightly more roughness when stroked downward than when stroked upward, but the roughness is nothing like the resistance felt on downward stroking of an average sample of any of the perforative grass spikes The latter are relatively smooth on upward palpation ("upward" and "downward" refer to the living position of the grass spike) When compressed between finger and thumb and then released, the awns and glumes of all the perforative grasses transmit a remarkable degree of efficiency in delivery of stored force of compression The resiliency of the perforative spikes is little, if at all, diminished by wetting By contrast with the perforative grasses, the palpation of an average dry specimen of timothy spike reveals little resiliency and when wet it is relatively soft and limp

Bronchoscopic Appearances —In the cases of lodged timothy panicles seen within a few days after inspiration there was an acute vegetal bronchitis In cases of long sojourn, the proximal end of the timothy panicle could be seen submerged in pus, of which the odor was foul After aspiration of this purulent accumulation, slight oozing of blood from granulations was noted After aspirating again, the proximal end (top) of the spike could be seen buried in granulation tissue Search of the literature has revealed no record of the appear ance of a perforative grass spike *in situ*. The only reported case in which bronchoscopic examination was made while a perforative grass spike was in the lung is that of Foster and Cody[4] The grass spike (millet grass) had disappeared The pathologic conditions noted were mucosal inflammation and a source of hemorrhage The spike was extruded through the chest wall a few days later

Symptoms of Grasses in the Bronchi and Lungs —These symptoms are those common to all foreign bodies in these regions The initial symptoms are choking, gagging, coughing and dyspnea, they are practically never absent, but may be *unobserved, ignored, unelicited or overlooked*[7 10 12 13 16] In almost all the published cases of grass spikes they were unelicited In more than half the cases they were volunteered by the relatives when shown the specimen bronchoscopically removed or spontaneously extruded Wheezing respiration (asthmatoid wheeze) usually accompanies the initial symptoms, but is not so commonly noted by lay relatives Then a symptomless interval intervenes. After that, the symptoms are those of the various common diseases of the lungs, such as productive cough, purulent sputum, often blood streaked, and, *after a time, usually foul* Soon the typical symptoms of chronic pulmonary sepsis develop, particularly chilliness sweats, irregular fever, weight loss, or oftener failure of the child to gain in weight. Pulmonary abscess is rare, but drowned lung is common In the baby who had a timothy panicle in his right bronchus for nine months (from 11 to 20 months of age) there was *intermittent discharge of accumu*lated foul sputum from the obstructed and drowned lower lobe bronchial tree As often occurs in right lower lobe foreign-body cases, in some of the perforating grass spike cases the patient had the symptom of tense right abdominal muscles, misleading to a diagnosis of appendicitis Subjective sense of presence is usually absent or not subjectively localizable. Two symptoms are common *a.* pain in the chest, not definitely localizable by the patient, and *b* hemorrhage Both of these are rarely, if ever, absent in case of perforating grass spikes

Doubtless the pleuritic type of pain is present for a short time and is localizable in these cases, but it is not mentioned in the case reports

Diagnosis — A working diagnosis of foreign body can be made in a child if a history of the just mentioned initial symptoms can be elicited by close questioning of the parents A diagnostic bronchoscopy will then be decisive in a case of the lodging type of grass head In the perforative type, however, bronchoscopy might be negative from the one-way-travel disappearance of the spike In one such case (Foster and Cody[4]) the source of hemorrhage was noted After the symptomless interval, suppurative symptoms call for a diagnostic bronchoscopy as part of a systematic complete diagnosis in any patient with pulmonary symptoms The *physical signs* early may show hyper-resonance or an impaired percussion note, according to whether obstructive emphysema or obstructive atelectasis is present Soon, however, drowned lung develops and dullness, almost always basal rather than apical, is present This dullness is usually mistaken for pulmonary abscess or pneumonia, both of which are rare in foreign body cases Differentiation from pneumonia is easily made by the absence of the typical auscultatory signs of lobar pneumonia as understood by the internist The published case reports show that too much importance has been given to the physical signs of percussion and too little to those of auscultation

Grass spikes are, of course, radioparent, but *Roentgen examination* is of utmost importance It should be done in every child with a history of the just mentioned initial symptoms, and also in every child with any pulmonary symptoms Grass spikes may show Roentgen signs of atelectasis or emphysema early, later, shadows of drowned lung appear, usually in a lower lobe, most frequently in the right This appearance has been misinterpreted as pneumonia or abscess, but the experienced radiologist of today will interpret it as drowned lung

Differential Diagnosis — Nearly all the published case reports show some of the pitfalls in differential diagnosis In addition to the just mentioned misinterpretations of pneumonia and pulmonary abscess, there were reported erroneous diagnoses of diphtheria, chronic bronchitis, bronchiectasis, asthma, tuberculous rib and pulmonary tuberculosis In two cases a misinterpretation of hard right-sided muscular tension misled to a diagnosis of appendicitis. Other pitfalls were in overlooking, ignoring of failure to elicit diagnostic symptoms of foreign body in the tracheobronchial tree

TREATMENT

Of seven cases of the *lodging type* of grass spike (panicle) the foreign body was bronchoscopically removed in all and all the patients recovered perfect health, general and local, without any sequelae, therefore, it may be said that no treatment other than bronchoscopic removal need be considered Long continued drowned lung in the lodged grass spike cases may call for a few subsequent bronchoscopic aspirations to expedite clearing of the tree

In case of a child with the initial symptoms of choking, gagging and coughing in surroundings that justify suspicion of inspiration of a grass spike, diagnostic bronchoscopy should be done at the soonest possible moment, because of the possibility of an inspirated grass spike of the one-way travel type Minimum elapsed travel time to extrusion in seven and eight days in some of the cases implies the possibility of a spike getting beyond the bronchi quickly, because this bronchial part, obviously, is the speediest part of the journey These postulates are supported by the previously mentioned case reported by Foster and Cody,[4] in which bronchoscopy, done two or three days after a spike of millet grass had been inspirated, indicated that the spike had already disappeared on its one-way travel

In case of a presumably perforative type of grass spike, or spikelet, that, because of its radioparency, has disappeared from reach of bronchoscopy *spontaneous* extrusion should be awaited This postulate, however, is subject to the opinion of the physicians and surgeons concerned in the care of the par-

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In case of a presumably perforative type of grass spike, or spikelet that, because of its radioparency, has disappeared from reach of bronchoscopy, spontaneous extrusion should be awaited This postulate however, is subject to the opinion of the physicians and surgeons concerned in the care of the particular patient "Presumably perforative type," as indicated by published clinical records, means all grass spikes other than timothy

So far as can be determined from the published reports of cases, no after-treatment was necessary in the typical perforative cases In the management of the dermal extrusion abscess, conservatism is of utmost importance All radical debridement, enlargement to improve drainage, and like surgical measures are contraindicated When the perforative spike presents itself, it can be lifted out and a sterile gauze pad can be held in place with adhesive strips Evidently barriers against spreading infection protect the adjacent tissues, and prompt healing follows the spike on its one-way travel and extrusion

PROGNOSIS

A remarkable feature of grass spikes as foreign bodies in the tracheobronchial tree is the absence of mortality and the prompt recovery of the patient from a serious pulmonary condition after the bronchoscopic removal, or the extrusion, of the foreign body

For example, in the *lodging type* of grass spike, a 20-month-old baby carried a timothy spike-like panicle 3 cm long in a foul area of drowned lung nine months with only intermittent natural peroral drainage, yet recovered rapidly and completely after bronchoscopic removal[12]

In the cases of the *perforative type* of grass spike the healing of the track following extrusion, the prompt healing of the dermal abscess and the rapid systemic recovery seem fully to justify a favorable prognosis

In 34 cases of inspirated grass spikes there was no mortality due to the foreign body The only death was from a bilateral pulmonary tuberculosis that was already at a serious stage before inspiration of the grass spike The transit of the grass spike did not seem to affect the progress of the tuberculous lesions The patient did not succumb to the pulmonary tuberculosis until nine months after the extrusion of the grass spike

SUMMARY

1 Considering the ubiquity of grasses, and especially the fondness of children for playing with them, their occurrence as foreign bodies in the tracheobronchial tree is extremely rare Including the 18 additional cases herewith tabulated, the total number of cases found in the literature is 35

2 Published case records and botanical examination of normal grass spikes and spikelets of the same genera as those reported indicate there are two distinct types of cases, dependent upon the genus of the grass inspirated

3 In one type (seven cases) the spike remained in the bronchus until removed bronchoscopically, in one case it had remained nine months in a 20 month-old baby In the other type (28 cases) the spike was driven through lung and thoracic wall and was extruded on the dermal surface. In most of the cases this was completed without empyema or pneumothorax. These are not cases of pulmonary abscess rupturing into the pleura. They are a morbid entity Empyema following pneumothorax was created by ill advised surgical enlargement of the fistula in search of an abscess, in some of the cases

4 One-way ratchet like travel of a bronchial foreign body toward the periphery has often been noted in cases of pointed objects such as pins, hat pins, open safety-pins and staples The greater driving force and penetrative efficiency in case of grass spikes are fully explained on the basis of the laws of physics and the botanical characteristics of the genera and species of the spikes recorded as having perforated the thoracic wall The source of all the power that drives the spike is the thoracic muscles The five mechanisms of application of this power are fully discussed.

5 Attention is called to pitfalls in diagnosis and postulates for guidance in clinical work are given

6 As a contribution to medical science, it is urged that the botanical classification of the spike or spikelet be determined and included in all future case reports of grasses as foreign bodies in the tracheobronchial tree

7 Prognosis is good Of a total of 35 cases, the only recorded death was from pulmonary tuberculosis that was in an advanced stage when the foreign body was inspirated Even in this case the patient (an adult) did not succumb to the pulmonary tuberculosis until nine months after extrusion of the grass spike

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THE DIFFERENTIATION BETWEEN SYMPTOMS REFERABLE TO THE OTOLITH ORGANS AND SEMICIRCULAR CANALS IN PATIENTS WITH NONSUPPURATIVE LABYRINTHITIS

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In describing the symptomatology of patients with labyrinthitis a distinction is usually drawn between symptoms referable to the auditory and non-auditory portions of the labyrinth Little attempt is made, however, to extend this differential symptomatology to the two components of the non-auditory labyrinth, namely, the semicircular canals and the otolith organs This report represents an attempt in making such a separation It is based mainly on a comparison of symptoms observed before and after unilateral labyrinthectomy in five patients with non-suppurative labyrinthitis, the spontaneous symptoms prior to treatment are compared with symptoms induced by differential stimulation of the otolith organs and semicircular canals following recovery

During the past few years many experiments have been carried out at the U S Naval School of Aviation Medicine[1] wherein healthy persons were subjected to angular acceleration, the physiological stimulus to the sensory elements of the semicircular canals, and to a change in direction of resultant force, the physiological stimulus to the otolith organs In the

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*Opinions or conclusions contained in this report are those of the authors They are not to be construed as necessarily reflecting the view or the endorsement of the Navy Department.

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course of these studies the differential symptomatology referable to these organs of special sense was observed and may be briefly summarized.

Among the cardinal symptoms following stimulation of the sensory elements in the horizontal canals are *1* nystagmus, *2* feeling of rotation *3* and the apparent motion of objects If more than one pair of canals are involved, the result of Coriolus accelerations, nausea and vomiting are readily induced These symptoms are well known, and, for the most part, have been fully exploited in the clinic.[3] The feelings of rotation are characteristic, with eyes closed one has the illusion of rotating about an axis which passes through the body and the feeling that the chair or other supporting structure likewise rotates. With eyes open the attention is chiefly centered on objects in the visual field The impression is gained that these objects are moving but that they are not displaced very far in space In other words they appear to drift without escaping from the visual field In addition to the cardinal symptoms mentioned the subject always has difficulty in walking and may have symptoms referable to many other bodily systems

Stimulation of the sensory elements in the otolith organs was accomplished by means of a human centrifuge The subject was exposed to a change in direction of resultant force with respect to himself, angular accelerations were small and were present only during the onset or cessation of rotation. The symptomatology was assumed to be characteristic of stimulation of the otolith organs although other sensory elements were also stimulated[14] The cardinal symptoms include *1* an apparent change in body position *2* the illusion that the supporting structures are tilting, and *3* an apparent movement of objects in the visual field The apparent change in position consists of a feeling of being tilted away from the vertical This feeling of displacement contrasts sharply with the feeling of apparent rotation following stimulation of the semicircular canals The subject also feels that the chair or other supporting structures tilt with him. Objects in the visual field appear to move and to assume a new position which accords with the apparent change in body position The apparent displacement is the striking feature and apparent movement is observed only with a change in the magnitude of displacement The absence of nystagmus and nausea is noteworthy Other symptoms are related to the magnitude of the force employed

The symptomatology referable to the semicircular canals and otolith is very different and it is relatively easy to detect these differences in the symptomatology of the cases now to be described It should be emphasized that this brief report is not intended to provide a full account of labyrinthine symptomatology in health or disease but is limited to those aspects which have come under our personal experience

CASE REPORTS

Case 1 C E a woman 41 years of age, was unusually well and strong until April, 1949, when she developed mumps Convalescence was complicated by tinnitus and loss of hearing in the right ear There were no further symptoms until six months later when she was awakened one night feeling nauseated and dizzy Subsequently she suffered numerous attacks They were characterized by a sudden onset of vertigo, nausea and vomiting The vertigo consisted of a feeling of rotation to the left and objects appeared to move to the left. The velocity of apparent movement varied from "slow to fast" The most helpful treatment was to remain absolutely quiet, even a slight movement of the head aggravated the symptoms and walking was impossible There were no illusions of tilting, this applied both to bodily position and to objects in the visual field The attacks usually lasted about an hour Between attacks she complained of nervousness, tinnitus and the dread of future attacks

Many forms of therapy were tried without avail and a right labyrinthectomy in the manner described by Day[3] was carried out in July, 1950 Following operation she had severe symptoms for three days, then gradually improved but experienced difficulty in walking for six months Recovery was complete save for tinnitus and deafness referred to the right ear

During July and August 1951, she volunteered to act as a subject in experiments designed to test the response to stimulation of the horizontal canal and otolith organs A comprehensive medical examination at that time revealed no significant abnormality other than a total loss of hearing and failure to respond to caloric stimualtion in the right ear The symptoms induced when she was subjected to a change in direction of resultant force on the human centrifuge were similar to those experienced by a healthy young person and did not resemble the spontaneous symptoms she suffered prior to operation, however when she was subjected to angular acceleration the feelings of rotation and the illusory movement of objects in the visual field although normal responses, closely resembled the spontaneous symptoms she experienced in the past

Comment The spontaneous symptomatology in this case was clear-featured Tinnitus and deafness were referable to the auditory system The feelings of rotation, and the apparent rotation of objects in the visual field closely resembled the symptoms induced following stimulation of the sensory receptors in the semicircular canals There were no spontaneous symptoms resembling those induced when the otolith organs were stimulated

Case 2 R. H., a woman 37 years of age suffered her first attack of dizziness in the Spring of 1947 prior to that time she was well and strong, save for a radical mastectomy in 1945 At first the attacks were infrequent and between times she felt well however they gradually increased in frequency and their duration ranged from a few minutes to three hours In addition to tinnitus and deafness the attacks were characterized by vertigo nausea and vomiting The vertigo consisted of the illusion of rotating to the right about an anteroposterior axis and of objects in the visual field rotating in the same direction The velocity of the apparent rotation was "very fast." She sought relief by lying still. Eventually she noticed tinnitus and nausea even between attacks and was fearful of leaving the house. Various forms of therapy afforded little or no relief and a right labyrinthectomy was performed in March 1949 Following operation she had severe symptoms which gradually decreased over a period of two months Following convalescence she had no further attacks Save for difficulty in orientating a source of sound she had no complaints. More specifically she did not experience any disturbance of equilibrium when walking by day or night or when in swimming.

She was a participant in the experiments carried out during the Summer of 1951 At that time a comprehensive medical examination revealed a total loss of hearing and failure to respond to caloric stimulation in the right ear She had normal hearing in the left ear but an abnormally decreased response to caloric stimulation especially of the vertical canals The symptoms induced following angular and centripetal acceleration were within the normal range. She stated that there was a close correspondence between the spontaneous vertigo and that induced following stimulation of the semicircular canals but that the symptoms induced following stimulation of the otolith organs had no counterpart in the spontaneous symptomatology

Comment The findings in this case closely resemble those in Case 1 The most noticeable difference was that the apparent rotation was in the frontal rather than the horizontal plane. This could be explained by involvement of different canals

Case 3 M. W a woman 46 years of age had suffered from earache on numerous occasions over a long period of time Five years previously following a severe cold she developed deafness and persistent tinnitus in the left ear One year later after eating a large amount of chocolate she suffered her first attack of nausea and vertigo The vertigo consisted of both visual and postural illusions The visual illusion was characterized by the apparent tilting and displacement of objects in the visual field. The tilting occurred gradually, never suddenly, and the slope was downward on the left The maximum degree of vertigo was approximately 45 degrees and after a period of minutes or hours, "things gradually returned to the level" She would "stare and fight" to prevent this phenomenon but with little or no success She denied having had the illusion that objects rotated or that they moved rapidly Coincident with the visual illusion she felt that she was "sliding off things" This tendency was worse with eyes closed and she would clutch onto bed or chair She discovered that this illusion of sliding was reduced if she was inclined backward about 45 degrees and remained quiet. Movements of the head might aggravate an attack Often she was unable to walk and was forced to crawl around the house

Little benefit was received from medical treatment, and labyrinthectomy on the left side was performed in February, 1949 Recovery was slow, but within six months she was able to resume her usual way of life Since that time she has felt well and there has been no recurrence of symptoms

Medical examination in August 1951 revealed no significant abnormality other than total loss of hearing in the left ear and failure to respond to caloric tests on this side Her response to tests on the human centrifuge were within the normal range and she stated that the feeling of being tilted and the tilting of objects in the visual field were similar to those she experienced during spontaneous attacks of vertigo prior to operation When subjected to angular acceleration she observed the apparent movement of objects in normal fashion but experienced no definite feelings of rotation other than a slight sensation of sliding"

Comment In contrast to the two cases already described the spontaneous symptomatology in this case corresponded more closely with symptoms induced following stimulation of the otolith organs rather than the semicircular canals, however, an indication that the latter were also involved is supported by the fact that the feeling of "sliding" was experienced spontaneously and following stimulation of the semicircular canals

Case 4 P W, a woman 45 years of age was never seriously ill until July, 1948 At this time she first noticed ringing in the ear and members of the family noticed she was slightly deaf The tinnitus resembled the after tone of a bell and was pulsatile in character she believed it was synchronous with the heart beat A few days later following a wedding festival, she suddenly developed headache, nausea vomiting and vertigo The vertigo was characterized by both visual and postural illusions Objects in the visual field appeared to drift rapidly to the right and at times vision was blurred In addition the entire visual field appeared to be sloping downward on the left The degree of slope varied and at times was "pronounced' With eyes closed she had the feeling that "things were going around" but that she was motionless Rarely she noticed a slight sensation of tilting but this was never sharply defined The attacks varied in duration but often lasted for hours Walking was impossible during an attack and she was fearful to leave the house between attacks

Various forms of therapy were tried without avail and in April, 1950 a right sided labyrinthectomy was performed She recovered slowly and in four weeks was able to walk. Save for two mild attacks she has had no subsequent complaints other than tinnitus and deafness Medical examination revealed no definite abnormality other than a total loss of hearing on the right and absence of any symptom following caloric stimulation on this side

Her responses to a series of tests involving selective stimulation of the semicircular canals and otolith organs were within the normal range. She reported that there was a resemblance between the spontaneous and induced symptoms and that this was especally true in the case of symptoms related to semicircular canal stimulation.

Comment The spontaneous symptomatology in this case was certainly related to the semicircular canals and probably to the otolith organs as well. The former predominated and correlated better with the induced symptoms

Case 5 Z. F a woman 47 years of age had suffered from dizzy spells for eight years The only important illness prior to that time was pulmonary tuberculosis discovered at the age of 28 which was arrested following treatment At the age of 39 one day while eating she felt "something pop in the right ear This was followed by a feeling of pressure which never entirely disappeared. After that day she noticed that on rotating the head toward the right she had a feeling of tumbling" in that direction. This was accompanied by malaise but not by vomiting. This recurred off and on for a year after which she was nearly free of symptoms for 18 months Thereafter the attacks increased in frequency and severity despite many different forms of therapy The symptomatology varied from one attack to another and even during the course of a single attack. With eyes open objects would appear to drift to the right sometimes slowly but often rapidly This apparent movement was always in the same direction and might "come and go for hours. In addition there were occasions when the entire visual field seemed to slope downward to the right. The degree of slope varied greatly and at times things were almost on end." With eyes closed she had strong feelings of clockwise rotation about the longitudinal axis. When seated she sometimes felt as though she were tilted backward and to the right. When lying she sometimes felt as though she were being slowly tilted backward, then forward, and sometimes from side to side. These illusions were accompanied by nausea but rarely by vomiting Between attacks in addition to tinnitus and deafness she usually had a feeling of floating' and instability

Inasmuch as all forms of medical therapy were of little value a right labyrinthectomy was performed in July 1950 Recovery was slow but eventually she was greatly improved and served as an experimental subject in the Summer of 1951. Medical examination at that time revealed a well developed and nourished person. The positive findings were as follows Teleroentgenogram of the chest revealed pathological changes consistent with an inactive tuberculosis process. Nystagmus, with fast component to the right was readily induced when gaze was directed about 20 degrees from straight ahead. There was total deafness in the right ear and caloric tests on that side provoked no response The Romberg test was slightly positive on some but not all occasions Tests designed to stimulate selectively the semicircular canals and otolith organs were carried out at times when she felt well, and the responses were usually within the normal range She readily associated the induced symptomatology in both instances with certain of the spontaneous symptoms and said they were "much the same '

Comment Although the spontaneous symptomatology in this case was severe, extensive and variable, yet it was possible to distinguish certain symptoms which were shown by later tests to be related to both sensory organs of the non-acoustic labyrinth It is also noteworthy that nystagmus induced in the four directions of gaze was characterized by the fast component to the right and this agreed with the visual illusion of objects drifting in this direction

DISCUSSION

It has long been known that the inner ear contains three organs of special sense which correspond to different physical stimuli Since the time of Goltz[4] a sharp distinction has been made between the organ of hearing and the so-called organs of equilibrium, and as the result of investigations of Mach,[5] Breuer[6] and others, a distinction is made between the static and dynamic portions of the non-acoustic labyrinth, nevertheless, the exact rôle of the semicircular canals and the otolith organs has not yet been fully elucidated, although recent studies have contributed to our knowledge, both with regard to the physiological mechanisms[7] and the psycho-physiological effects of stimulation[8] Much more is known concerning the effects of stimulation of the semicircular canals than of the otolith organs for the following reasons In the case of the semicircular canals the physiological stimulus is angular acceleration, which is absent when a person is at rest but provided under limited controllable conditions, hence differences between the two states can be easily studied In the case of the otolith organs, which respond to the force of gravity or to rectilinear acceleration, the sensory elements are stimulated even when a person is at rest, and controlled changes in stimulation are produced with difficulty This difficulty can be overcome only if a human centrifuge is available

Only those persons who have experienced the effects of angular and rectilinear acceleration under proper conditions in the laboratory can have a firm appreciation of the postural and visual illusions which are induced These illusions are extremely characteristic,[14] leaving no room for confusion The differential symptomatology includes much more than the perception of the illusion, and we have emphasized the fact that nystagmus is never referable to stimulation of the otolith organs and that nausea is usually referable to stimulation of the semicircular canals.

Keeping this differential symptomatology in mind, it is possible, in some cases of labyrinthitis, at least, to distinguish between certain symptoms which originate in the semicircular canals and otolith organs. Because the sensory receptors for both organs are in a single labyrinthine system it is to be expected that both might be stimulated by a common pathological factor In the five cases described above, spontaneous symptoms referable to the otolith organs predominated in one case and were present in two others. This suggests that symptoms referable to the semicircular canals are more common, but it is necessary to add, that until the symptomatology referable to the otolith organs is more widely appreciated cases in which these symptoms prevail may be missed

It is only to be expected that differences will be found between the spontaneous symptoms of patients with labyrinthitis and symptoms induced in healthy persons or even in patients between attacks This is due in part to the fact that the spontaneous symptoms result from pathological stimulation and in part to the fact that the induced symptomatology has not yet been fully explored It would be worthwhile in studying patients during an attack, to inquire closely regarding illusions of tilting and to determine the accuracy with which they estimate the horizontal or vertical position The latter test should be carried out by having them adjust a luminous rod in a dark room or a rod placed before a uniform background A fuller appreciation of symptoms which may arise from disturbances of the otolith organ should lead to a better recognition of certain cases of labyrinthitis.

SUMMARY

Five patients with symptoms characteristic of non-suppurative labyrinthitis were partially or wholly relieved following unilateral labyrinthectomy After recovery from the operation they were subjected to both angular and rectilinear accelerations which stimulated respectively the sensory elements in the horizontal pair of semicircular canals and otolith organs The symptoms induced following stimulation of the semicircular canals were feelings of rotation and the apparent rotation of objects in the visual field The chief symptoms induced by a change in direction of resultant force, which included stimulation of the otolith organs, were an apparent tilting of the body and the apparent displacement of objects so that they appeared to assume a new position in space When their spontaneous symptoms were interpreted in the light of the induced symptoms, it became evident that the disturbances in equilibrium might be mainly referable either to one or both portions of the non-acoustic labyrinth The spontaneous disturbances were mainly referable to the semicircular canals in two cases, the otolith organs in one, and to both sensory organs in the remaining two

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We are grateful to Prof Hallowell Davis for his help in initiating the study to CDR Earl Wolf MC, USN for carrying out caloric tests and to Lt Vernon Bragg, USN for audiometric examinations It is also a pleasure to acknowledge the technical assistance of Miss Frances Clopton Clayton S Ezell, HMC USN D I Herrett HMC USN and the staff at the Acceleration Unit at the Naval School of Aviation Medicine Above all we are grateful to Mrs Pauline M Webb Mrs Zella O Foutz, Mrs C Lucille Edwards Mrs Rosa Jean Haas and Mrs Charles H Worheide who served as experimental subjects

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RADIOACTIVE IODINE IN THE DIAGNOSIS AND TREATMENT OF LINGUAL THYROID ADENOMA *

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Lingual thyroid is uncommon Its diagnosis without biopsy has not been feasible until the recent development of radioactive isotopes By the use of radioactive iodine and the directional scintillation counter the distribution of thyroid tissue can be clearly established It is thus possible to locate abnormally situated thyroid tissue and to eliminate thereby other possibilities in the differential diagnosis of masses at the base of the tongue It can help to decide whether medical treatment or surgical treatment — or both — are to be carried out

The following case report presents an enlightening history, demonstrates the use of radioactive iodine preoperatively, describes the easiest type of operation for removal of large tumors at the base of the tongue, records the postoperative radioactive studies, and suggests a modification of part of the theory regarding the development of the thyroid gland

Case 741486 On June 20, 1951, a 30 year-old white, divorced woman entered the Massachusetts Eye and Ear Infirmary because of dysphagia. During the past six weeks the dysphagia had seemed to be increasing On exertion there was difficulty in getting the breath, and the patient had more trouble breathing when lying down than when erect. She had noted that her voice was nasal

These symptoms were not entirely new She first noted difficulty in swallowing about five years ago Periodically she had attacks that her doctor called sore throats Often adenitis was present. On several occasions penicillin had been give to cure the "sore throat." Because of this difficulty in swallowing and breathing an inhalation anesthetic was deemed unwise five years ago Instead, intravenous anesthesia was used for salpingectomy and appendectomy At least four different physicians had employed a tongue depressor to examine her throat at various times

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the past five years Except for inflammation no abnormality had ever een detected She had had no serious illnesses Her family history was ot relevant.

Examination revealed a normally developed short (153 cm.) small 52 6 kg) woman She was alert and intelligent. Her skin was normal in exture and moisture. Her voice was nasal and somewhat muffled suggesting that the use of the tongue was impaired. She made moderately visible efforts on attempting to swallow Her eyes were slightly prominent with slight enlargement of the palpebral fissures Eye movements were normal. The pupils were equal and reacted to light and accommodation. The ears demonstrated normal auricles canals and drums. The hearing was normal In the nose the mucosa was pink and moist. The septum was not obstructive The turbinates were normal in size and shape and were found to shrink readily The nasopharynx was normal.

Examination of the mouth showed no questionable teeth. The gums were normal. The buccal mucosa, hard and soft palates were normal The tonsils were out and the fossae clean The anterior two-thirds of the tongue were normal. At the base of the tongue in the midline at the region of the foramen caecum there was a horse chestnut sized rubbery feeling mass. Slightly lobulated firm and broadly attached to the tongue, this mass was 3 cm. in diameter It projected above the surface of the tongue at least 2 cm. It was not movable except by motion of the tongue itself Its size and location clearly accounted for the patient s complaints pertaining to deglutition respiration and speech Movements of the tongue were normal.

The pharynx hypopharynx and larynx were normal

On examination of the neck, the larynx was found to be in the mid line The thyroid and cricoid cartilages were normal. The tracheal rings were easily palpated as the neck was rather thin There was no palpable thyroid gland isthmus or lateral lobe There was no evidence of pyramidal lobe or of thyroglossal duct. No regional cervical adenopathy was apparent. The submaxillary glands were normal in size and shape No abnormal masses were found in palpation of the neck.

In the thorax the lungs were clear and resonant to auscultation and percussion The heart was normal.

The abdomen showed the scar of a previous operation. There were no abnormal masses and no tenderness or other abnormalities were noted.

The extremities were normal in appearance and in function

The blood pressure was 100/70 Pulse and respiration were within normal limits Urine tests were normal The R. B C was 3,940 000 the Hgb 1*6 gm the W B. C. 7 900 with a normal differential. Blood Hinton was negative. N P N was 25 mg./100 cc. The F B S. was 83 mg./100 cc. The B M R was —7

The lateral neck X rays showed the mass at the base of the tongue but no other abnormalities were apparent. The chest was normal by X ray and there was no evidence of intrathoracic thyroid

The thyroid service at the Massachusetts General Hospital was consulted to see if radioactive iodine could be used to establish the absence of a normal thyroid gland as well as the absence of any other abnormally placed thyroid gland tissue. Dr B M. Dobyns and his colleagues carried out all of the work pertaining to radioactivity They pointed out that as far as laboratory procedures go radioactive iodine studies held a definite and unequalled place Radioactive iodine studies made it possible to determine whether or not the mass at the base of the tongue contained functioning thyroid tissue and, secondly, whether there was any other thyroid tissue functioning elsewhere

The patient was given orally a drink containing 100 microcuries of radioactive iodine (131) (half life is eight days) with 10 gamma of sodium iodide as carrier Forty eight hours after administration, a directional scintillation counter was used to scan the patient from the area of the pharynx to the manubrium Since the individual's fields surveyed were no larger than 2 sq cm, an area counted laterally at the angle of the jaw coincided with the tumor mass at the base of the tongue and was found to contain the majority of the radioactivity A survey between this point and the thyroid area revealed only a minimal amount of radioactivity apparently contributed by the area of high concentration in the tongue base The survey over the thyroid area revealed no more radioactivity than our other control areas of the neck or thoracic cage The conclusion was obvious that the patient had a lingual thyroid tumor and no other functioning thyroid tissue

On the fourth hospital day, operation was performed by Dr Moses H Lurie and the authors Intravenous pentothal anesthesia was employed. After cocainization of the larynx, a No 29 Magill intratracheal tube was passed through the nose into the trachea In the sitting up position the hypopharynx was carefully packed with moistened gauze The base of the tongue was exposed with a special technique A pair of No 2 chromic catgut sutures were passed one on either side of the midline through the tongue one inch behind the tip Traction on these sutures enabled a second pair of sutures to be passed through the tongue one inch behind the first sutures Traction, steady and constant, permitted a third pair of sutures one inch behind the second set Further traction and a fourth pair of sutures provided maximum extension of the tongue It is always remarkable how far forward the posterior third of the tongue can be brought by the above maneuver In this case the lingual thyroid tumor was nicely exposed A mass the size of a golf ball was easily enucleated with scissors and blunt dissection The posterior portion of the dissection was completed with a tonsil snare All bleeding points were controlled The tongue slipped back into its original position as the sutures were removed The specimen was sent to the laboratory for special studies The patient withstood the operation well and was returned to her bed in good condition.

The postoperative course was uneventful For the first two days postoperatively intravenous fluids were administered as swallowing was difficult. From then on the patient took increasing amount of fluids by mouth with less and less discomfort Penicillin and streptomycin were given for one week The temperature remained flat. The patient's general condition was excellent.

Forty eight hours after operation the patient was resurveyed with the directional counter The area of high concentration of radioactivity in the region of the base of the tongue had disappeared There was now only a slight amount of activity in this region This meant that a slight amount of thyroid tissue was still present and functioning at the base of the tongue

On the eighth postoperative day the patient was discharged home No medication of any sort was given, as it was unlikely that myxedema would develop before the next admission for recheck with radioactive iodine

The surgical specimen removed was described grossly as spherical in shape measuring 4 5 cm. in diameter Small projections of muscle were adherent to one-half of the surface of the mass The surface of the remaining half consisted of a smooth glistening whitish capsule. Several plaque-like masses of reddish brown tissue were present just beneath the capsule. Sectioning of the mass revealed a multiloculated cyst (see Fig. 1) containing yellowish-brown fluid. When placed in the field of the directional scintillation counter the entire surgical specimen was shown to contain a large amount of radioactive iodine (131) No para thyroid tissue was found on close examination of the specimen.

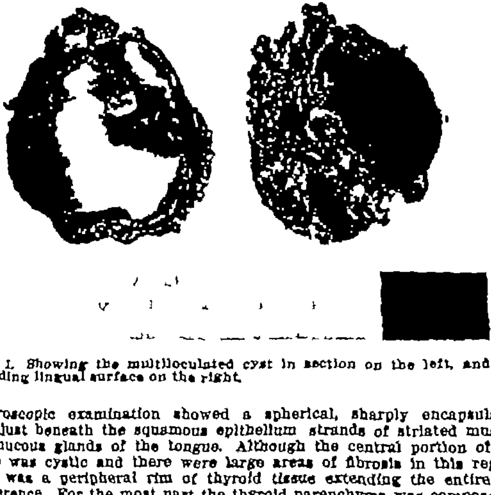

Fig 1. Showing the multiloculated cyst in section on the left, and the protruding lingual surface on the right.

Microscopic examination showed a spherical, sharply encapsulated mass just beneath the squamous epithelium strands of striated muscle and mucous glands of the tongue. Although the central portion of the tissue was cystic and there were large areas of fibrosis in this region there was a peripheral rim of thyroid tissue extending the entire circumference. For the most part the thyroid parenchyma was composed of small follicles—many of which were nonlumenated Scattered acini were of a normal size and contained colloid. These latter were more abundant at the margin of the mass. The described follicles were distributed in a ground glass-like eosinophilic matrix characteristic of an adenoma. There were no connective tissue septa ramifying throughout the adenoma. In a few areas at the circumference of the encapsulated adenoma were islands of normal appearing follicles (see Fig. 2) which appeared to have been compressed and displaced by the enlarging adenoma. These conceivably represent remnants of normal thyroid. The radioautograph disclosed a narrow (see Fig 3) zone of darkening around the circumference of the adenoma this corresponded to the scattered colloid containing follicles within the adenoma and also with the previously noted foci of probably normal thyroid tissue The cystic element of the adenoma and also the microfollicular areas comprising the bulk of the nodule showed no corresponding film darkening.

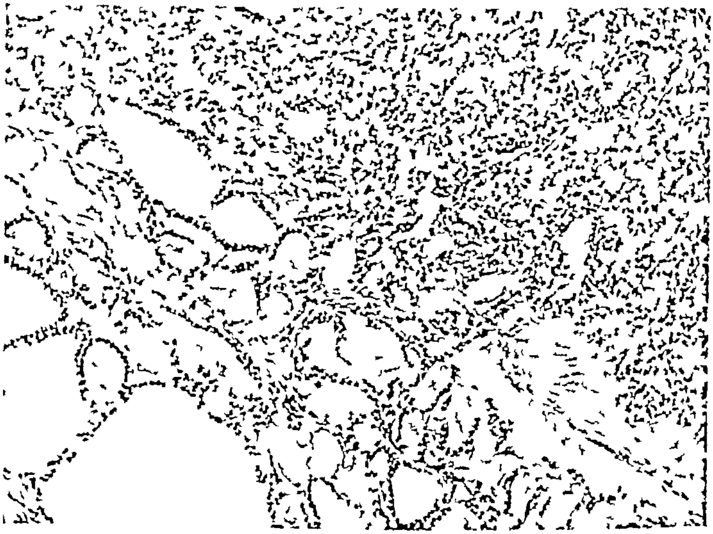

Fig 2 Showing microfollicular adenoma at the right above compressing normal appearing follicles at the left below lying just beneath the fibrous capsule (×425)

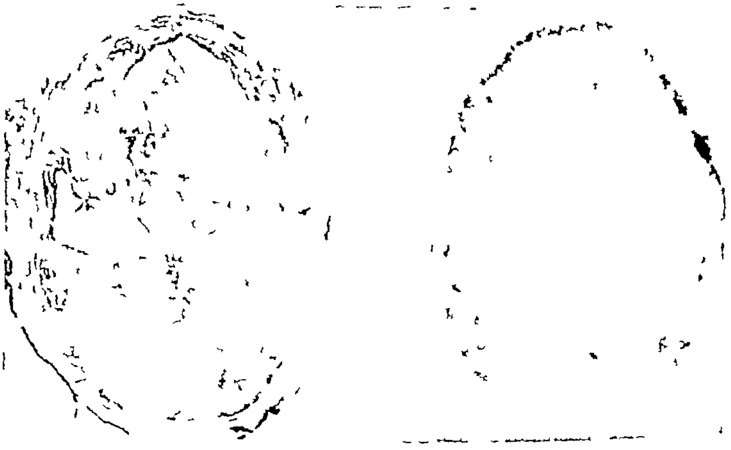

Fig 3 Illustrating use of radioautography the right-hand photograph shows the narrow zone of darkening around the periphery of the adenoma shown in the left photograph In the dark a portion of unexposed film was placed over the section and it 'took its own picture The two photos are superimposable.

The diagnosis confirmed by Dr Austin Vickery of the Pathology Department of the Massachusetts General Hospital[3] was adenoma, thyroid principally microfollicular type with central cystification and fibrosis

On July 30 1951 five weeks after her operation the patient was readmitted to the Massachusetts Eye and Ear Infirmary She had no complaints and felt only trivial twinges of discomfort on swallowing She had gained six pounds in weight in the past month.

The physical examination was as before except that at the operative site there was a *slight hollow* at the base of the tongue. Complete blood studies were normal. The urine tests were normal. The B M R was —15.

Five hundred microcuries of radioactive iodine (131) with 10 gamma of sodium iodine as a carrier were given orally in the second hospital day Urine specimens were examined *for three days At the end of 48* hours a Geiger counter was passed over the operated area and the entire neck. There was radioactivity demonstrable over the base of the tongue and none elsewhere as shown by the following figures with the background radiation count averaging 220 counts per minute subtracted from the total count over various areas of the anterior neck to be enumerated the actual intensity of radiation over the usual thyroid area showed only 33 counts per minute over either side of the trachea and suprasternal area zero to four counts per minute but at the tongue base the count rose to 1 327 per minute The low count at the level of the cricoid was interpreted as scattering from the lingual base. Urine studies showed that 20 per cent of the radioactive iodine had been absorbed by the remaining thyroid gland tissue Thus it was proven that actively functioning thyroid tissue remained in the lingual area.

The patient was in excellent general condition except for the slightly lowered B. M. R. She was discharged from the hospital on Aug 2 1951 on 60 mg. of thyroid daily An appointment to return to the Out Patient Department in two months could not be kept because the patient had moved to another state She *reported that she was symptom free* and that her weight was constant. Thyroid medication was continued and she promised to return in another two months for check up

DISCUSSION

The case shows how careless doctors are at times in examining the throat. This patient repeatedly complained of dysphagia over a period of six years At various times at least four doctors assured the patient after examination that her throat was normal Her difficulty in breathing was sufficiently distressing so that intravenous rather than inhalation anesthesia was employed While we may question the choice of anesthesia, it is remarkable that the posterior third of the tongue was not examined before or during the operative procedure

The sudden onset of dysphagia six weeks prior to admission suggests the possibility of hemorrhage into a cystic cavity The finding of yellowish-brown fluid on sectioning tends to confirm this suspicion

The appearance and feel of the swelling at the base of the tongue preoperatively suggested thyroglossal cyst as the best diagnosis Dr Dobyns felt that the slight lobulation was indicative of adenoma In that his forte is thyroid surgery, we paid little attention to his written diagnosis until the microscopic examination proved him correct Because there was no true epithelial lined cyst, the diagnosis could not be thyroglossal cyst It was adenoma of the thyroid with cystic degeneration

The operative procedure was designed for the removal of a cyst rather than the complete removal of all thyroid present The microscopic and radioactivity studies proved the correctness of this type of surgical removal All of the encapsulated cystic adenoma was resected, leaving behind apparently normal lingual thyroid

This is the first case at the Massachusetts Eye and Ear Infirmary in which radioactive iodine studies have been used to diagnose lingual thyroid The fact that there was no indication on physical examination of any thyroid tissue in its usual location indicated that the mass at the base of the tongue might be thyroid, and perhaps the only thyroid the patient possessed This situation was diagnosed conclusively by the use of radioactive iodine (131) and the very sensitive directional scintillation counter preoperatively No other additional sites of thyroid remnants were discovered, and the conclusion was that this patient had her thyroid in the tongue and that it had never migrated caudally during her embryological period

The use of radioactive iodine in an effort to solve a problem in embryology is unusual in that the present case presented herself 30 years after the thyroid anlage had been laid down According to Patten, in addition to "the median bilobed primordium that arises from the floor of the pharynx at the level of the second pouch (see Fig 4) near the end of the fourth week, there also arise on the caudal face of the fourth pharyngeal pouches small diverticulae known by various names but more simply as postbranchial bodies All authors agree that the diverticulae in question break loose from the fourth pouch and become incorporated with the lateral lobes

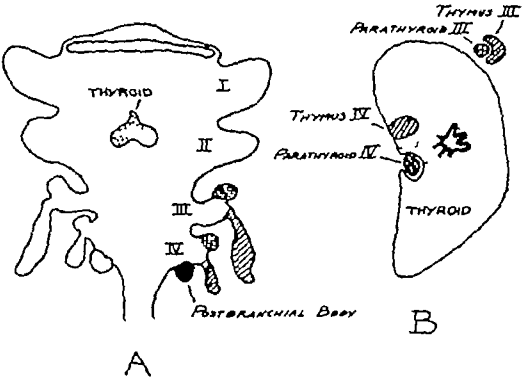

Fig. 4 (Adapted from Patten) (A) The postbranchial body is in black and early in development is widely separated from the median thyroid primordium. (B) A later stage in development showing inclusion of the postbranchial body (black) within the migrating thyroid.

of the median thyroid primordium as it reaches posterior pharyngeal levels in its migration caudad Once associated with the thyroid lobes, the tissue of the postbranchial origin tends to become buried in them and its subsequent history is difficult to follow The only question is whether, in this position within the thyroid, the postbranchial tissue actually gives rise to typical thyroid follicles or merely remains as a vestigial inclusion of unknown significance"*

The present case seemed to us to be an ideal "critical experiment" to find out exactly what does become of the post branchial bodies and if they really do form thyroid tissue The use of radioactive iodine was of decisive help in clarifi

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Bradley M. Patten Human Embryology 1948, pp. 520-521.

cation of this point as it localizes in thyroid tissue wherever it may have formed or migrated The first administration of radioactive iodine and the subsequent localizing by use of the directional scintillation counter revealed that the only radioactivity was at the base of the tongue, there being little or no radioactivity along the usual course of the migrating gland and none in the upper thorax The possibility still remained, however, that other sites of thyroid tissue were masked by the high concentration of activity at the tongue base, therefore, a second counting one month later was done and again revealed thyroid tissue in the tongue base *only* and in no other location If the ultimobranchial bodies do form thyroid follicles, then the radioactive iodine should have localized elsewhere in the neck, but our patient showed no other site than the tongue base

The conclusion is that, in the absence of migration of the thyroid primordium and the incorporation of the postbranchial bodies in the gland, these bodies do not contribute thyroid follicles to the adult gland Of course, whether or not the presence of the median primordium is essential to transform the postbranchial bodies into functioning thyroid tissue is not answered by this paper It seems definite, however, that the postbranchial bodies do not by themselves form thyroid tissue

CONCLUSIONS

1 With a history of dysphagia and dyspnea, it is amazing that this patient could go through an operation under general anesthesia and be cared for repeatedly during five years by physicians without having her hypopharynx examined

2 When a tumor involves the lingual thyroid area, radioactivity studies should be done to determine the exact location and function of thyroid tissue in the patient

3 Suture traction of the tongue provides an excellent exposure of the posterior third of the tongue for the surgical removal of tumors or cysts

4 Since cystic degeneration commonly occurs in adenomas of thyroid tissue, surgical removal is preferable to medical treatment.

5 The distribution of radioactivity in this patient throws new light on the embryological development of the thyroid gland.

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THE IMPORTANCE OF NUTRITIONAL SURVEYS IN OTORHINOLARYNGOLOGIC PRACTICE*

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The patients that present themselves to otorhinolaryngologists with symptoms and complaints referable to the ear, nose and throat fall principally into three general classifications first, those with a purely local disease, local in origin and largely local in manifestations, second, those with local manifestations of diseases that are generalized in character or distant in origin, and the third class is a combination of the first two groups

Since nutritional failure is a generalized condition with many and varied localized manifestations, it is the purpose of this paper to study those manifestations that affect the field of otorhinolaryngology and more especially to evaluate the methods for nutritional study that may efficiently and conveniently be used in everyday clinical practice

INCIDENCE OF NUTRITIVE FAILURE

The incidence of nutritive deficiency varies in different population groups and varies also with the criteria used for measuring deficiencies Moose,[1] citing a relatively recent National Research Council report, states that about two-thirds of the American public is suffering from a nutritional deficiency Biskind and Williams[2] surveyed 183 boys in a children's institution and found that 90 per cent had glossitis, 67 per cent, gingivitis, 19 per cent suffered from cheilosis, and 60 per cent had symptoms of avitaminosis related to the nervous system Pierce[3] and his associates found evidences of inadequate nutrition in 85 per cent of a group

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of Vermont school children Adamson *et al.*[4] very carefully studied 868 representative residents of Newfoundland and noted signs of malnutrition in a large percentage Thickened conjunctiva was present in over 76 per cent, cheilosis in 68 per cent, and active severe dental caries in 61 per cent. Other signs were present in lesser proportions In another study, also in Newfoundland, McDevitt and associates[5] studied seasonal variations in blood values of vitamin C Many were found deficient, especially among the mothers The main clinical lesions were gingivitis, dental caries and hyperkeratosis Out of 284 patients studied carefully by clinical histories and physical examinations, they found that 233, or 82 per cent, showed deficiency in at least one of the vitamin B components Most individuals presented multiple deficiencies Kruse[6] studied 143 persons in a low income group and found gross evidence of xerosis in 45 per cent and microscopic evidence of xerosis conjunctivae in an additional 54 per cent (total, 99 per cent)

Perhaps one of the best and most recent surveys is that of Spies,[7] who carefully examined 10,851 persons Nutritive failure was found in over half of the individuals, namely, 5,711 cases. It becomes readily apparent that well over half of the American public suffers from varying degrees of nutritional failure and we may assume that among patient groups who seek medical advice, because of various complaints, the proportion must be still greater Thus, the average physician who, on any given day, sees 30 average patients in his consultation rooms can be quite certain that 15 to 20 of those patients would undoubtedly be benefited by nutritional investigation and guidance. Statistics of group studies from other parts of the world bear a similar relationship A particularly informative paper has been published by Gillman and Gillman[8] on the problem as it affects Negroes and whites in South Africa.

THE NATURE OF NUTRITIVE FAILURE.

It is not within the scope of this paper to review in detail all of the signs and symptoms of nutritive failure associated with the respective nutrients Standard reference works by such authors as Youmans[9] and McLester[10] quite adequately portray that part of the problem Most writers on the subject agree that rarely is there a nutritional deficiency of only one or two nutrients Most deficiencies involve multiple nutrient factors

One of the earliest signs of nutritional failure is fatigue, in its varied forms Associated with this may be various feelings of nervous tension Almost any digestive disturbance can be a symptom of nutritional failure as is a host of dermatologic conditions More specifically, in the field of otorhinolaryngology we should suspect the possibility of nutritional irregularities if there is evidence of dental or gingival disturbances, soreness, fissuring and atrophy of the tongue and lips, sinusitis, postnasal drip, nasal or other allergy, chronic pharyngitis and sometimes dysphagia Even the aural system may reveal nutritional deficiencies and in our neighboring field of the eye there are often signs of vitamin A and riboflavin deficiency

HISTORICAL

Recently, Strauss[11] reviewed the otolaryngologic literature available in the year 1850 Among other items he found that a nourishing diet was advised by one author for otitis media Another writer reported the "cure" of a facial and orbital malignant tumor by a bread and milk diet (Incidentally, a Boston newspaper records the obituary of the "cured" patient six months later, the cause of death not being stated) When comparing this paucity of nutritional interest in our field with the many excellent factual articles being written each year at the present time, we can see that real progress is being made in the field of nutrition as it relates to otolaryngology

Furstenberg,[12] in 1949, chronicled 100 years of otolaryngology and a perusal of his paper reveals little or no reference to nutrition until the end of the paper when he mentions amino acid therapy in surgical problems Nevertheless, the field of nutrition was being covered by enthusiastic pioneers

J A. Stucky,[13] early in this century, pleaded for nutritional studies to be made in rhinologic patients His disciple, D C Jarvis,[14] later carried the torch, and Eugene R Lewis[15] likewise was an early advocate of nutritional evaluation in our field of practice.

In more recent years the contributions of Roberts[16] and Moose[1] and the yearly contributions by Isaac Jones[17] and his associates stand out as milestones of progress in otolaryngologic nutrition.

Excellent reviews have also been given by Perlman,[18] Cody,[19] Wallner,[20] Beck[21] and Coakley [22] Even the foreign literature[23] has made excellent contributions Many of the early papers on otolaryngology and nutrition contained much conjecture, and the conclusions were often based upon circumstantial evidence, however, as the field of nutrition in general has become clarified from year to year, the ideas and concepts as they pertain to otorhinolaryngology have also begun to crystallize into more factual patterns

COMMON LESIONS

As stated previously, rarely do we find nutritional deficiencies due to the lack of a single food factor More commonly, many factors are involved, however, there are certain lesions in our anatomical field that seem to represpent to a large extent specific deficiencies Seborrheic lesions about the eyes ears and nares may be associated with a riboflavin deficiency, as evidenced by improvement under specific therapy The fissures at the corner of the mouth, irritated lips and cheilosis are also evidences of a riboflavin lack Atrophy of the tongue papillae redness and soreness and fissuring of the tongue are usually associated with B complex deficiencies, especially niacin. These lesions are commonly seen in so-called pernicious anemia, sprue, and in certain cases of diabetes Martin and Koop[24] have published an excellent paper on the ' Precancerous Mouth Lesions of Avitaminosis B " This should be read by every practitioner who looks into a patient's mouth In their work at the Memorial Hospital in New York they have clearly demonstrated that the degenerative mucous membrane lesions in and about the mouth produced by avitaminosis B, very definitely favor the subsequent development of cancer on the site of these lesions

Dental caries is a very definite evidence of nutritional failure, past or present or both The monumental work of Price[22] has clearly settled this question Gingivitis, with or without bleeding, suggests ascorbic acid and calcium deficiencies

Roberts[16] states that hypertrophied lymphoid follicles in the pharynx can represent an iodine deficiency There are some workers who feel that such hypertrophies may also be associated with an insufficient intake of unsaturated fatty acids or so-called vitamin F Goodale[20] has reported a case of laryngitis apparently due to B complex vitamin deficiency The patient also had a sore tongue and esophageal distress Personally, I have observed two cases with esophageal pain and distress in which esophagoscopic examination revealed only a smooth atrophic lining resembling somewhat the smooth tongue of vitamin B deficiency Both patients had definite evidence of vitamin B deficiency in their diet One was relieved by appropriate dietary guidance The other patient was an alcoholic and lived at a great distance and has not been observed again His mouth and lips presented typical evidences of riboflavin and niacin deficiencies

Jarvis[14] postulated a nasal syndrome due largely to the use of an excess of acid ash food in the diet He stated that a pale nasal septum mucosa indicated too much acid and a more red mucous membrane a more alkaline dietary intake He reported relief of nasal symptoms by changing the diet from acid ash to alkaline ash In the light of more recent nutritional knowledge, one is led to wonder if the improvement obtained was purely one of acid versus base, or whether the basic foods did not supply certain other beneficial nutrients that had no direct acid-base relationship

Roberts[16] has proposed a nutritional failure syndrome based upon six main points, namely

1 Postnasal mucus drip without sinus infection

2 Sensation of nasal stuffiness without organic obstruction

3 Sinus pain without sinus infection

4 Fatigue without organic findings

5 Neuritis

6 Allergic manifestations

Every rhinologist has seen many of these unhappy patients and some of us, due to our ignorance many years ago, may have contributed to their unhappiness by performing unwise operations upon them In more recent years our surgical conservatism has increased and we are now able to help these patients by nutritional therapy and guidance after first ascertaining the cause of the nutritional failure

In the past 20 years much interest has developed in the nutritional approach to deafness and vertigo Guggenheim[27] obtained some encouraging results in vitamin and mineral therapy of otosclerosis Covell[28] studied the otic capsule in avitaminotic animals and described various bone and soft tissue lesions, but could report no definite vitamin therapy approach to ear disease Mellanby[29] studied puppies with avitaminosis A and noted serous labyrinthitis as well as bony lesions in the vicinity of the cochlear and vestibular nerves Perlman[30] in his studies of young rabbits was able to produce bone lesions when vitamin A was lacking, but no cochlear impairment could be shown He advises caution in concluding that avitaminosis A is important in deafness Lawrence[31] was unable to confirm the histologic findings of Mellanby[29] and found no behavioral responses indicating hearing loss in vitamin A deficient rabbits More recently, Lobel,[32] Anderson et al.[33] and Bau and Savitt[34] have reported encouraging results in progressive deafness and tinnitus with massive doses of parenterally administered vitamin A. Further reports on this work may prove to be interesting

Atkinson[35] has reported on the use of large doses of niacin and riboflavin in Ménière s disease and feels that deficiency of the two factors plays an important rôle in the etiology In this connection it should be pointed out, however, that in the work of Atkinson[35] and Lobel[33] the dosages of vitamins used are far in excess of any conceivable physiologic requirements for those vitamins Their therapeutic effect, hence, may in part be pharmacologic instead of altogether nutritional For example, the vasodilating effect of niacin

During World War II, DeRaadt[23j] studied Allied prisoners of war in Japanese camps in the Far East He found 160 patients with otoneurologic syndromes due to malnutrition Many were pellagrins and he suggests that Ménière's syndrome may be associated with "monosymptomatic" pellagra of an early stage Though a niacin deficiency is the prominent factor of pellagra, he stresses that it is actually a deficiency of multiple factors A riboflavin lack was deemed to be largely involved in bringing out central nervous system lesions The work of Atkinson[35] takes on added interest in view of the findings of DeRaadt [23j]

Selfridge[36] had previously reported on the use of vitamins in deafness, and more recently he reviewed the nutritional and endocrine factors in Ménière's disease He felt that electrolytes, vitamins and endocrine secretions play an important rôle in the etiology In the neighboring field of ophthalmology we naturally think of xerosis ophthalmia and night blindness as frequent evidences of vitamin A deficiency Corneal vascularization may indicate riboflavin deficiency, but this is not an infallible test, as pointed out by Lyle *et al* [37]

Elderly people have been shown by Rafsky and Newman[38] to give frequent evidence of subclinical deficiency disease In 38 carefully studied, apparently normal aged individuals they found vitamin deficiencies in 75 per cent My personal experience indicates that this percentage would be quite representative in my own practice

During the past few years much interest has centered about the hypoprothrombinemia which is so often produced after tonsillectomy by the use of acetylsalicylic acid, used for the relief of pain This condition can be relieved or largely prevented by the pre- and postoperative use of vitamin K.[39] Fox and West[40] feel that in addition to the vitamin K deficiency in postoperative hemorrhage cases there may be a protein deficiency They advocate a preoperative study in each patient to include a search for constitutional and dietary disorders

The role of nutrition in surgical patients has in recent years received much deserved attention For the healing of soft tissue wounds adequate protein, ascorbic acid and other nutrients are essential Bone wounds need calcium, phosphorus and vitamins B, C and D in particular

Elman[41] has pointed out that protein deficiencies are actually prevalent in clinical medical and surgical practice, and that the average physician often fails to recognize this fact. If the patient is temporarily unable to ingest, digest or absorb protein foods, amino acid therapy should be given orally or parenterally as indicated An excellent bibliography and literature abstract booklet is available on the subject of "Proteins in Relation to Surgery,"[42]

Holman[43] studied the incidence of dietary deficiency in 70 patients from the low economic levels admitted to surgical wards for surgery He found that 44 per cent of the patients had lower than normal vitamin C intakes An additional 13 per cent were found to be on the verge of clinical scurvy

NUTRITION AND ALLERGY

A patient who is allergic to foods may present a serious nutritional problem if the allergenic foods are important staple foods or are many in number The avoidance of many of these staples may actually aggravate the allergy because of the secondary malnutrition. As otorhinolaryngologists we see many of these individuals and it is our duty to assist these patients in their nutritional rehabilitation. It is not sufficient to limit ourselves to multitudinous skin tests and to the administration of desensitizing antigens or vaccines. Such an approach to the allergy problem does not uncover or relieve certain of the underlying causes of the allergic state which must obviously be metabolic derangements, part of which are often nutritional The concept that a nutritional deficiency might be a basic cause for an allergic state is not altogether new, for Russell Wilder[44] has stated, "Yet some evidence suggests that allergy itself may be occasioned by unbalanced diets."

Oelgoetz[45] and associates, in an excellent paper published in 1934, postulated, and seemed to have shown, that normal individuals have adequate amounts of pancreatic enzymes circulating in the blood stream to digest various foreign proteins and incompletely digested proteins which might gain entrance into the blood stream. Allergic individuals usually have a deficiency of these circulating enzymes. I have personally verified this latter fact in my own laboratory on many occasions. Consequently, Oelgoetz[45] points out that individuals with low blood enzyme titers who might eat too much at one time, place such a great load upon the digestive system that much incompletely digested protein may be absorbed, with the result than an acute allergic reaction ensues. Such patients need careful adjustment of their eating and living habits to avoid the sudden strains on their weakened enzyme system. I know that others besides myself have had the gratifying experience of seeing marked improvement or remissions in allergic individuals by merely correcting their eating habits and assuring a full nutrient supply without the necessity of avoiding certain foods and without desensitization programs. Dorothy Clark[46] has recently published an excellent paper on the treatment of allergic conditions from the endocrine standpoint, following some of the concepts put forth by Oelgoetz.[45] Other excellent papers in this same general field, dealing with proteins in allergy are those of Adams[47] and Vermilye and Thompson.[48] They point out that allergic patients often fail to digest and utilize protein foods and they are often benefited by protein hydrolysates. In my clinical practice I have found this to be true, and I am certain that the metabolic approach to the allergy problem will eventually overshadow the immunologic approach. The recent success with Cortisone in asthma is an encouraging milestone of metabolic progress, though it is not the final solution to the asthma problem.

NUTRITION AND THE ENDOCRINE SECRETIONS.

In their action in the body, both vitamins and hormones act as catalysts in the various metabolic reactions Whereas the former are largely obtained from without the body in our daily food, the latter are largely elaborated within the body Accordingly, the two classes must be considered together, and no practice of nutrition is adequate without some consideration of the related hormones.

Sieve[49] has published an excellent series of papers on the subject in which he shows the very important and intimate interrelationship between vitamins and hormones Jungck and Heller[50] have also provided a most useful summary of the more common features of nutrition in endocrinology For example, androgenic failure may produce a lack of mineral retention and will make nutritional correction difficult if the androgen failure is not compensated They state, "One may infer that the hormones increase the efficiency of utilization of proteins and minerals, and that in the absence of the hormones, the nutrients, if given in large enough quantity, can (possibly by the law of mass action) in part overcome the hormonal deficiency insofar as the metabolic defects of such a deficiency are concerned" Many patients with impaired nutrition are unable to handle large quantities of foods Consequently, we cannot depend for results upon excessive and massive doses of nutrients in these patients, but must secure optimum utilization of such nutrients as proteins and certain minerals by the use of androgens or other hormones appropriate to the individual patient.

The dependence of the thyroid hormone upon adequate food iodine is, of course an old and classic example of the problem at hand but as otolaryngologists our endocrine approach must extend beyond the dispensing of thyroid hormones.

METHODS OF STUDY

There are at least seven methods by which we obtain information relative to the nutritional state of our patients. They may be classified as follows

1 *Patient's complaints* These are symptoms or signs that the patient volunteers as he brings his complaints to the physician For example, a sore tongue, or bleeding gums These would suggest nutritional failure

2 *Further symptoms of nutritional failure not complained of by the patient, but elicited in the nutritional history* For example, a patient with a sore tongue may not think to volunteer to a laryngologist that he also has excessively soft or liquid stools, as in sprue (The method of eliciting a nutritional history will be given below)

3 *Living habits, diseases or drugs* which either alter the patient's ability to digest and assimilate nutrients or which produce an added requirement for certain food factors Examples are no breakfast, light lunch and a heavy evening meal Obviously such a patient cannot maintain optimum nutrition Patients with achlorhydria or "colitis" obviously do not utilize their foods to the optimum Users of mineral oil may lose many fat soluble vitamins

Nutritional therapy will often result in failure if living habits which prevent optimum food utilization are not ascertained and corrected Too great stress cannot be laid upon this point for it is very important

4 *The diet eaten* This is elicited in the nutritional history and its sufficiency or deficiency determined

5 *Physical examination* for evidences of malnutrition Otolaryngologists should make at least a limited number of observations outside of the ears, nose and throat For example, weight, blood pressure, skin, hands, hair, eyes, etc

6 *Laboratory tests* For example, allergic individuals often show a lowered pancreatic function and sometimes increased serum potassium A patient may have hyperinsulinism A glucose tolerance test will be decisive and the therapy consists, in most instances, of a simple regulation of the patient's eating habits

7 *Therapeutic test* Occasionally verification of our tentative diagnoses must await the therapeutic test

THE NUTRITIONAL HISTORY

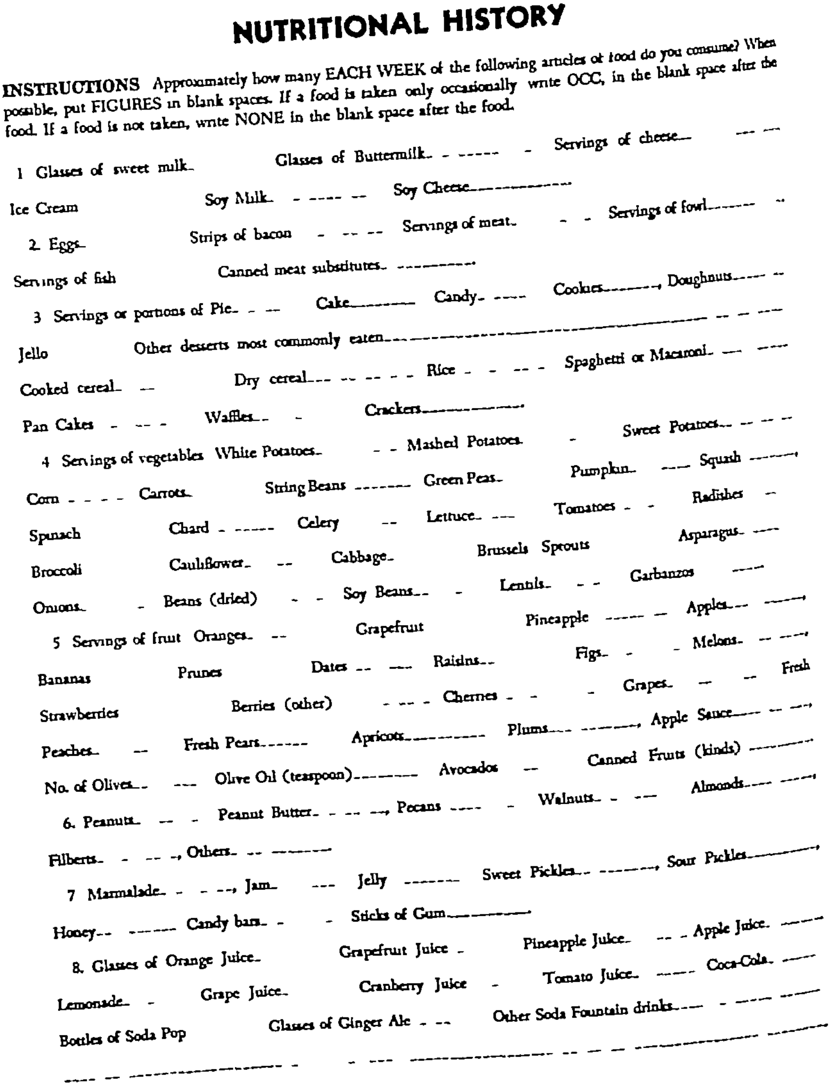
The taking of an adequate nutritional history can be a very time-consuming procedure and is practically an impossibility in the average clinical practice, if the physician elicits it orally himself In large clinics trained technicians might do the work, however, if a questionnaire type of history is used, much time can be saved by the busy practitioner as the patient records the history at home Various history forms and outlines have been recommended by Moose,[1] Roberts,[14] Levinton,[21] Spies[7] and Burke[22]

Obviously any dietary history can suffer from inadequacies, but it is still a very useful tool, as pointed out by Burke,[22] and it does fill a need Some nutritionists try to overcome the deficiencies of a history by obtaining an inventory of all foods eaten for two weeks and then tabulating the amounts of the various nutrients, minerals, etc., as derived from food tables This method, too, leaves room for possible error As in any history, the patient's veracity is involved Then comes the question of the quality of the food, where it was grown how it was harvested and shipped, how it was prepared, etc. Finally, after the patient ate the food, did he utilize it fully? Burke[22] reported no consistent success in obtaining seven-day *menus* from patients, and she recommends that only a one-day menu be recorded

The nutritional history form which I use is patterned somewhat after that of Roberts[14] with various modifications Two pages are devoted to the several groups of foods and two pages to living habits and symptoms which might pertain to the patient's nutrition. As a check against the patient's estimate of his dietary habits he records his entire menu for two days This is a very valuable feature.

Simple language is used so that any patient who can read can use the history As can be seen (see Fig 1) from the reproduced history it is crowded together to conserve space in filing, etc. On the occasion of the patient's first visit he receives the history with brief instructions on the importance of the form and its use. The form is executed at home and consumes at least an hour of time in the average case It is then mailed to the office or brought back on the occasion of the second office visit

FIG 1, PAGE 1



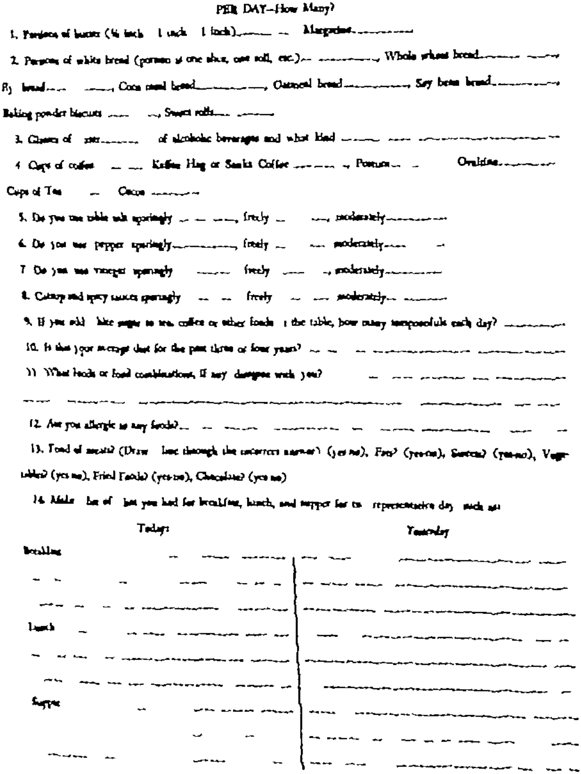
NUTRITIONAL HISTORY

INSTRUCTIONS Approximately how many EACH WEEK of the following articles of food do you consume? When possible, put FIGURES in blank spaces. If a food is taken only occasionally write OCC, in the blank space after the food. If a food is not taken, write NONE in the blank space after the food.

1 Glasses of sweet milk____ Glasses of Buttermilk____ Servings of cheese____
Ice Cream____ Soy Milk____ Soy Cheese____
2. Eggs____ Strips of bacon____ Servings of meat____ Servings of fowl____
Servings of fish____ Canned meat substitutes____
3 Servings or portions of Pie____ Cake____ Candy____ Cookies____, Doughnuts____
Jello____ Other desserts most commonly eaten____
Cooked cereal____ Dry cereal____ Rice____ Spaghetti or Macaroni____
Pan Cakes____ Waffles____ Crackers____
4 Servings of vegetables White Potatoes____ Mashed Potatoes____ Sweet Potatoes____
Corn____ Carrots____ String Beans____ Green Peas____ Pumpkin____ Squash____
Spinach____ Chard____ Celery____ Lettuce____ Tomatoes____ Radishes____
Broccoli____ Cauliflower____ Cabbage____ Brussels Sprouts____ Asparagus____
Onions____ Beans (dried)____ Soy Beans____ Lentils____ Garbanzos____
5 Servings of fruit Oranges____ Grapefruit____ Pineapple____ Apples____
Bananas____ Prunes____ Dates____ Raisins____ Figs____ Melons____ Fresh
Strawberries____ Berries (other)____ Cherries____ Grapes____
Peaches____ Fresh Pears____ Apricots____ Plums____, Apple Sauce____
No. of Olives____ Olive Oil (teaspoon)____ Avocados____ Canned Fruits (kinds)____
6. Peanuts____ Peanut Butter____ Pecans____ Walnuts____ Almonds____
Filberts____, Others____
7 Marmalade____, Jam____ Jelly____ Sweet Pickles____, Sour Pickles____
Honey____ Candy bars____ Sticks of Gum____
8. Glasses of Orange Juice____ Grapefruit Juice____ Pineapple Juice____ Apple Juice____
Lemonade____ Grape Juice____ Cranberry Juice____ Tomato Juice____ Coca-Cola____
Bottles of Soda Pop____ Glasses of Ginger Ale____ Other Soda Fountain drinks____
____

The questions and items are grouped in such a manner that the physician with a little practice can analyze the chart, detect the important points, and mark these with a red pencil, in a total of about three minutes in the average case

FIG 1 PAGE 3



PER DAY—How Many?

1. Portions of butter (½ inch 1 inch 1 inch) ______ Margarine ______

2. Portions of white bread (portion is one slice, one roll, etc.) ______, Whole wheat bread ______, Rye bread ______, Corn meal bread ______, Oatmeal bread ______, Soy bean bread ______, Baking powder biscuits ______, Sweet rolls ______

3. Glasses of water ______ of alcoholic beverages and what kind ______

4. Cups of coffee ______ Kaffee Hag or Sanka Coffee ______, Postum ______ Ovaltine ______ Cups of Tea ______ Cocoa ______

5. Do you use table salt sparingly ______, freely ______, moderately ______

6. Do you use pepper sparingly ______, freely ______ moderately ______

7. Do you use vinegar sparingly ______ freely ______, moderately ______

8. Catsup and spicy sauces sparingly ______ freely ______ moderately ______

9. If you add white sugar to tea, coffee or other foods at the table, how many teaspoonfuls each day? ______

10. Is this your average diet for the past three or four years? ______

11. What foods or food combinations, if any, disagree with you? ______

12. Are you allergic to any foods? ______

13. Fond of meats? (Draw a line through the incorrect answer) (yes no), Fats? (yes-no), Sweets? (yes-no), Vegetables? (yes no), Fried Foods? (yes-no), Chocolate? (yes no)

14. Make a list of what you had for breakfast, lunch, and supper for two representative days, such as:

Today: Yesterday

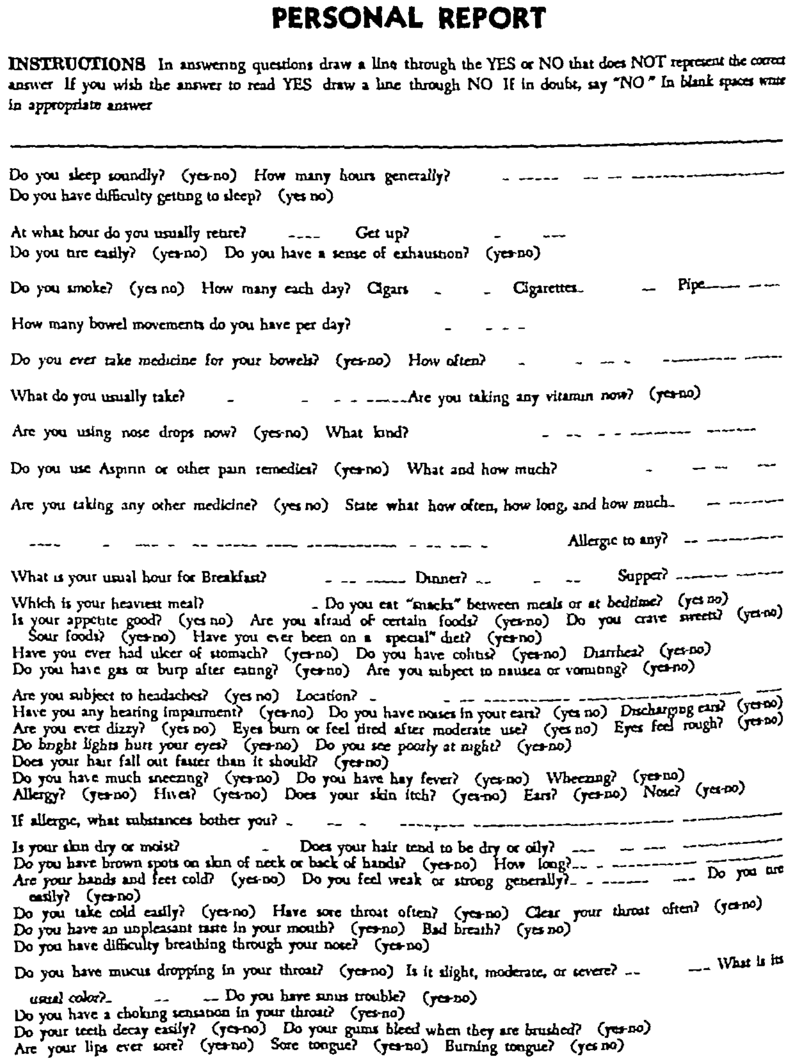
Breakfast

Lunch

Supper

Then follows the consultation with the patient in which the pertinent facts of the history are discussed, together with any correlated physical and laboratory findings If some features

FIG 1, PAGE 3



PERSONAL REPORT

INSTRUCTIONS In answering questions draw a line through the YES or NO that does NOT represent the correct answer If you wish the answer to read YES draw a line through NO If in doubt, say "NO" In blank spaces write in appropriate answer

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Do you sleep soundly? (yes-no) How many hours generally? ____
Do you have difficulty getting to sleep? (yes no)

At what hour do you usually retire? ____ Get up? ____
Do you tire easily? (yes-no) Do you have a sense of exhaustion? (yes-no)

Do you smoke? (yes no) How many each day? Cigars ____ Cigarettes ____ Pipe ____

How many bowel movements do you have per day? ____

Do you ever take medicine for your bowels? (yes-no) How often? ____

What do you usually take? ____ Are you taking any vitamin now? (yes-no)

Are you using nose drops now? (yes-no) What kind? ____

Do you use Aspirin or other pain remedies? (yes-no) What and how much? ____

Are you taking any other medicine? (yes no) State what how often, how long, and how much ____

____ Allergic to any? ____

What is your usual hour for Breakfast? ____ Dinner? ____ Supper? ____

Which is your heaviest meal? ____ Do you eat "snacks" between meals or at bedtime? (yes no)
Is your appetite good? (yes no) Are you afraid of certain foods? (yes-no) Do you crave sweets? (yes-no) Sour foods? (yes-no) Have you ever been on a special" diet? (yes-no)
Have you ever had ulcer of stomach? (yes-no) Do you have colitis? (yes-no) Diarrhea? (yes-no)
Do you have gas or burp after eating? (yes-no) Are you subject to nausea or vomiting? (yes-no)

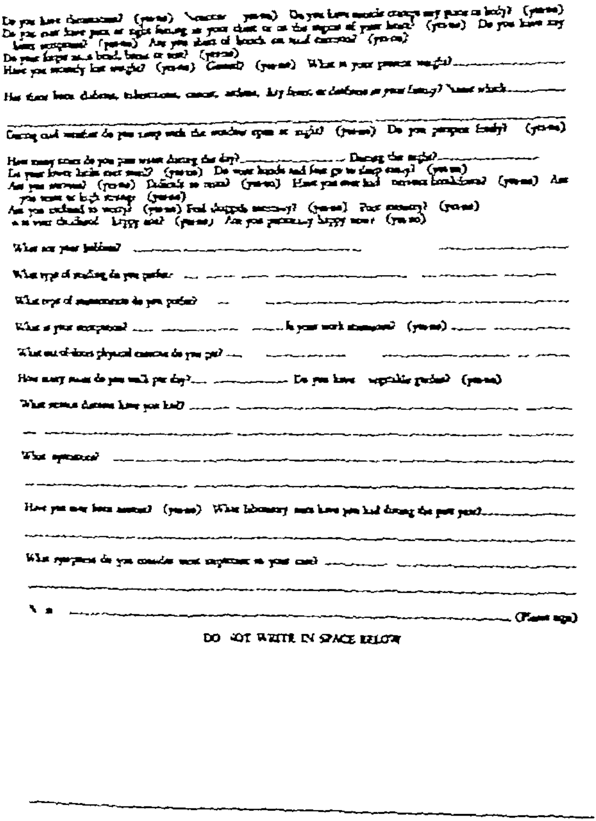
Are you subject to headaches? (yes no) Location? ____
Have you any hearing impairment? (yes-no) Do you have noises in your ears? (yes no) Discharging ears? (yes-no)
Are you ever dizzy? (yes no) Eyes burn or feel tired after moderate use? (yes no) Eyes feel rough? (yes-no)
Do bright lights hurt your eyes? (yes-no) Do you see poorly at night? (yes-no)
Does your hair fall out faster than it should? (yes-no)
Do you have much sneezing? (yes-no) Do you have hay fever? (yes-no) Wheezing? (yes-no)
Allergy? (yes-no) Hives? (yes-no) Does your skin itch? (yes-no) Ears? (yes-no) Nose? (yes-no)

If allergic, what substances bother you? ____

Is your skin dry or moist? ____ Does your hair tend to be dry or oily? ____
Do you have brown spots on skin of neck or back of hands? (yes-no) How long? ____
Are your hands and feet cold? (yes-no) Do you feel weak or strong generally? ____ Do you tire easily? (yes-no)
Do you take cold easily? (yes-no) Have sore throat often? (yes-no) Clear your throat often? (yes-no)
Do you have an unpleasant taste in your mouth? (yes-no) Bad breath? (yes no)
Do you have difficulty breathing through your nose? (yes-no)

Do you have mucus dropping in your throat? (yes-no) Is it slight, moderate, or severe? ____ What is its usual color? ____ Do you have sinus trouble? (yes-no)
Do you have a choking sensation in your throat? (yes-no)
Do your teeth decay easily? (yes-no) Do your gums bleed when they are brushed? (yes-no)
Are your lips ever sore? (yes-no) Sore tongue? (yes-no) Burning tongue? (yes no)

FIG 1, PAGE 4



need further elucidation the physician can quickly ask the necessary questions, and if further laboratory studies are needed these can now be planned.

On the basis of the above findings most of the necessary nutritional guidance can be given on the occasion of the second office visit It is not my practice to use printed stock diets Most instructions are given orally and an attempt is made to build the new diet as closely as possible around the patient's old diet, based upon his racial, cultural and family background Our percentage of success in dietotherapy will be considerably lowered if we make routine, sweeping, radical changes in the diets of our patients Most alterations of that type are unpleasant to the average ambulatory individual. Occasionally it is of course necessary to make drastic changes

A recent interesting report on the value of nutritional therapy has been provided by Rawlings[53] Among 315 children, 125, or 39 5 per cent, gave evidence of present impaired nutrition, 227 children had not had previous tonsil and adenoid surgery and of these, 139 were found to be in need of such surgery All 227 children were placed on vitamin and mineral supplementation therapy as seemed indicated in each case In three to 32 months all but six of the 139 children had been improved to the point where tonsil and adenoid surgery were deemed to be not necessary Not only was infection lessened by nutritional therapy, but the children developed better appetites, gained in weight, increased growth, improved in their school work and evidenced better attitude and behavior patterns

The physician who attempts to give nutritional advice should be well versed in standard texts such as the American Medical Association Handbook of Nutrition,[54] Youmans,[9] McLester,[10] Wohl[44] and Sherman[55] An excellent monthly review is also available for the busy practioner[56] Most patients are deeply grateful for sound nutritional advice, they appreciate knowing why certain habits are helpful or harmful A few minutes of time spent in explaining in simple language a bit of body chemistry and physiology creates a desire in the patient to adjust his living program so that health can reasonably be expected In our nutritional counseling we are not so much interested in prescribing exact amounts of specific nutrients as we are in instructing the patient concerning the dietary principles he should follow in improving his diet.

Our therapy in nutrition must be based upon an adequate history We would deem it ridiculous to prescribe drugs without bothering to take a clinical history Might we not ask if it is not equally ridiculous to hand out (prescribe) printed diet sheets for certain conditions without first obtaining a nutritional history? Spies[7] has aptly said ' It is deemed unwise for the physician to approach any patient without a complete study on which he can base his therapy " Nutritional therapy is sometimes dramatic and *may occasionally* produce quick results On the other hand, in the words of Spies [7] "It must be kept in mind, however, that nutritive failure usually has taken months or years to develop and it cannot be overcome quickly"

There may be some otolaryngologists who would prefer to refer their patients to a nutritionist for therapy For such the *nutritional* history *form* would still be very useful as a screening device to determine which patients should be referred.

ANAYSIS OF SERIES

I have recently evaluated 500 nutritional histories obtained in my private practice of otorhinolaryngology *Analyses of* consecutive segmental groups of the histories in the series of 500 showed such a close similarity in percentage findings in each group that it became clear that no substantially greater value could be gained *from a larger series even though* more histories were available for analysis It would require a substantial book if we were to tabulate each question used in the questionnaire, *so only* a few salient points will be discussed herein

Calories In an ambulatory clinical practice I have not found much necessity for counting calories as a routine measure The quality of food and how it is utilized are more important than the absolute quantity of food ingested. A rather quick glance at the diet history will suggest whether or not the total calories are correct The handiest index of adequacy of calorie consumption is of course the body weight Normal caloric requirements are modified in any given case by such factors as age, sex, skeletal size, body metabolism, occupation, climate, disease, etc

Protein Only 13 per cent of our series of 500 were deemed to have inadequate protein intakes While we did not weigh and count the calories, the obvious deficiencies recorded against these patients were such that guidance as to protein intake was imperative for those individuals In addition there were other patients who could well afford some advice on proteins to improve the quality and variety of their fare in order to assure a "safe" margin above their minimal needs

Carbohydrates Eighty-one per cent of the series ingested what could reasonably be considered an excess of refined carbohydrates, *i e* , refined sugar and white flour products Cowgill,[57] in 1939, estimated that about one-half of the average American's diet (caloric value) consisted of white flour and refined sugar When one considers how much of these two substances is hidden in many of our supposedly good foods the figures are not difficult to believe In some urban centers the percentage is undoubtedly higher than 50 per cent The reader may ask what standard I used as *excess* in this series Again I must state that the food was not weighed, but to illustrate we would regard a weekly diet with several helpings of ice cream, several of pie and cake, doughnuts, candy or gum daily, "soda pop" several times weekly, the exclusive use of white bread, and daily sugar in the coffee and on the cereal as hardly a wholesome program Undoubtedly the excessive use of refined carbohydrates is the major nutritional error in America today So-called uncivilized tribes, when they begin to use our carbohydrate delicacies, soon acquire some of our "civilized" diseases such as dental caries (see Price[25]) In advising our patients of their nutritional status we endeavor to explain why such things as excessive amounts of refined carbohydrates are injurious We explain their local action in the mouth and digestive tract, and then their systemic action in depleting the B vitamins in the course of their metabolism.

Fruits and vegetables These were grouped together for convenience. Thirty-five per cent of our patients had such a poor total amount or variety of these foods as to be considered below "average." Too little fruit seemed to be a more common error than too few vegetables, and had we analyzed the fruit intake separately a larger percentage would no doubt have been obtained In our geographic location many individuals seem largely to satisfy their fruit menu with citrus juices. This is a serious error There are many sufferers in our vicinity with perennial hay fever or allergic rhinitis Some of these individuals, though not sensitive to oranges *per se*, will get allergic flare-ups if they drink heavily of orange juice. A probable explanation is that the readily available high potassium content of the oranges further upsets the potassium sodium ratio in the blood, which is already leaning too heavily to the potassium side.

Breakfast Eighty-four per cent of our patients did not eat an adequate breakfast. Some ate no breakfast, others merely a hasty snack, and others a breakfast too stereotyped, or lacking in good quality proteins, fruits and vitamins The importance of this problem has been recognized in recent studies. Jackson and Schuck[18] found inadequate breakfasts in university women and on checking grade school children, ages nine to 14, they found them likewise failing to eat adequate breakfasts Of 1,300 children studied, only 4 per cent could be said to have had adequate breakfasts from a nutritional point of view

Gallaway and Robertson[19] studied school children in Toronto in cooperation with the teachers Those pupils without proper breakfasts were more often fatigued and inattentive than those eating better breakfasts Blood sugar values could not be correlated. Tucker,[20] in a Kansas school survey reported that almost 8 per cent of the children ate no breakfast. Tuttle Wilson and Daum[21] found that work output and reaction time were often unfavorably affected by an inadequate breakfast, especially where coffee was used as a substitute for nourishing food An excellent study on blood sugar values in relation to various types of breakfasts has been published,[62] and the inadequacy of many meals served in industrial plants has been carefully documented by Goodhart[63]

Supper In addition to scanty breakfasts many individuals eat a hasty and ill-planned lunch and then try to make up the deficiency by gorging themselves with a heavy dinner at the supper hour This is most unnatural After a night of serene rest the digestive organs are best able to receive a heavy meal, therefore, breakfast should be substantial in quantity and quality, to prepare the body for the energy and maintenance needs of the day At noon, when half of the daily work is completed, the body is still able to handle a sizeable meal and requires further energy for the remaining duties of the day By evening, after a day of frustrations in modern life and when the body is least able to handle a heavy meal, most Americans eat their heartiest meal If the individual retires at a reasonable hour the food is still in the stomach, being only half digested, and the would-be sleeper may wonder why he has insomnia and other distresses We recognize that much of our modern industrial life seems almost to necessitate a heavy evening meal, nevertheless, where possible and where necessary, our patients will be benefited nutritionally if some adjustment is made in this matter In the present series we found that 63 per cent of the patients ate their heartiest meal in the evening

Snacks between meals Since gastric digestion requires four to five hours, at least five hours should elapse between each meal Digestion is essentially a series of chemical processes and it is common knowledge that imperfect results are obtained in any chemical reaction if ingredients are added now and then to suit a fickle fancy Any housewife knows that a poor plate of beans will result if intermittently a spoonful of dry beans is tossed into the kettle after the main mass is half cooked Yet, that is the way many persons treat their digestive organs and processes To make matters worse the foods most commonly eaten between meals are the sweet and devitalized foods. In the present series 48 per cent of the individuals ate nutrients between meals Sometimes just the correction of this one habit will result in much improvement in health.

Laxatives *Roberts*[16] *has stressed the* seriousness of the laxative habit. Not only will mineral oil dissolve out fat soluble vitamins and cause them to pass out in the feces, but as much as 35 *to* 60 *per cent of* the oil may be absorbed into the bowel wall, blood stream, lymph nodes and even the liver[44] Other laxatives likewise interfere with normal bowel motility, digestion and absorption. The laxative habit is usually easy to relieve by assuring a normal diet with adequate fruit content, and plenty of water taken one-half hour before meals. Even an otorhinolaryngologist who corrects his patients' living habits and habits of eating may have *gratified* patients who are no longer enslaved to the laxative habit or the enema tube. In our series 58 per cent used laxatives.

Drugs A relatively small percentage of our series engaged in self medication, other than laxatives, on a large scale, so we did not tabulate them, nevertheless, it is an important point in human nutrition. Whether self-administered or taken upon a physician s prescription, such drugs as the sulfonamides can reduce the vitamin C content of body tissues (see report by Pelner[45]) Even penicillin has been regarded as an antivitamin in its chemical degradation process[46] The effect of antibiotics in destroying nonpathogenic bowel bacteria that synthesize certain vitamins is *of course so well known as to* require no further comment. The relationship of acetyl salicylic acid to vitamin K has been discussed earlier in this paper

Special diets In our history we inquire into the use of so-called 'special diets" in the past Many patients are placed on such diets (often printed stock diets for certain diagnoses) by physicians or dietitians and then adhere to them indefinitely, long beyond a reasonably intended time Spies[7] has shown by analyzing various "special diets" commonly used by physicians that essentially all of them are deficient diets. The obvious conclusion must be that if such diets are used for any length of time, instead of *curing* disease, they will produce disease There is no "special diet" that is a good substitute for a nutritious diet

The eyes Earlier in this presentation the importance of vitamin A in corneal integrity and in visual dark adaptation has been discussed Our series finds that 63 per cent of the patients complained of visual distresses (see page 3 of history) Interestingly enough, there were a number of instances of very obvious and severe dietary inadequacy in which the patients had no visual complaints It must also be kept in mind that refractive errors, industrial lighting situations and many other factors can produce eye distress Such distress is not necessarily nutritional in origin, but in occasional cases may prove suggestive

Symptoms referable to the nervous system In our history (see page 4) we elicit evidences of nervous system disturbances such as a feeling of nervousness, tension, worry, mental sluggishness, etc While these are nonspecific complaints and may indicate a functional disturbance or possibly even a reasonably normal reaction to the great frustrations and perplexities of present-day life, they still may be suggestive of nutritional failure An excellent review of the available literature on the subject was recently presented[67] The review points out that it has been shown by a number of workers that symptoms of psychoneurosis can readily be produced in human experimental avitaminosis B, particularly with reference to thiamin deficiency The nervous system findings in pellagra are well known The depleting effect of refined carbohydrate diets on the B vitamins has previously been discussed

Jolliffe[68] in an excellent paper has recognized the problem and has outlined a program of vitamin therapy on a broad nutritional base to be used in neuropsychiatric disorders In my series 79 per cent of the patients recorded symptoms referable to their neuropsychiatric life I do not claim that these symptoms prove the presence of nutritional failure, but they are symptoms which should cause us to search for evidences of nutritional inadequacy

SUMMARY

1 Nutritive failure in varying degrees is prevalent in possibly half or more of the American population Most deficiencies are multiple and involve more than one nutrient element.

2 Many of these individuals will present themselves as patients to otorhinolaryngologists because so many of the symptoms of malnutrition evidence themselves in this field of practice.

3 There is a growing awareness of this problem among otolaryngologists.

4 A careful nutritional study should include a careful nutritional history as well as physical examination and proper laboratory tests

5 A rather simple history form which conserves the physician's time has been presented

6 In a survey of 500 such histories the excessive use of refined carbohydrates and gross irregularities in meal time habits were found to be among the more outstanding dietary errors.

7 Nutritional guidance can be made simple, yet effective, in clinical practice

CONCLUSIONS

Modern otorhinolaryngology requires that nutritional investigation and guidance be made available by the physician to the patient, to the end that optimum health may be regained and also maintained [7]

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CARCINOMA IN SITU IN OTOLARYNGOLOGY *†

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Carcinoma *in situ*, or preinvasive carcinoma, is being diagnosed with increasing frequency in many fields of medicine.[2,3] This is a logical development of the emphasis being placed upon early diagnosis as one of the fundamentals in the concerted campaign against cancer These early carcinomas were first detected in the skin and in the uterine cervix [1,4,5] Comparatively recently carcinoma *in situ* is being found in other areas including the field of otolaryngology Several groups of significant numbers are being collected in otolaryngological centers [1] however, at this time and until the concept of carcinoma *in situ* has been more widely attained, whenever such a diagnois is made by the pathologist, immediately there may be injected into the clinical problem a doubt as to the exact meaning of this pathologic terminology

A precise understanding of the significance of carcinoma *in situ* is a prerequisite to selection of proper treatment. How does it differ from conventional carcinoma? Is it actually malignant? Will it invade and how soon? Should it be treated differently from other types of carcinoma? These are some of the questions which complicate the choice of therapy The purpose of this paper is to review some of the basic steps in the evolution of this diagnosis, in so doing to clarify the concept of this term, and by selected case reports to illustrate some of the problems in the management of carcinoma *in situ* in otolaryngology

Extensive literature has accumulated on the subject of cellular studies and preinvasive carcinoma. Increasing knowl-

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edge of the characteristics of the malignant cell, accide
discovery of unsuspected carcinoma *in situ,* especially in
cervix, and cytological studies stimulated by Papanico
have made possible the rapidly increasing number of case
carcinoma *in situ* which are being diagnosed in practicall
fields of medicine

The clinical importance of recognizing early cancer is c
ous and has been stressed by numerous authors Mallory
said that carcinoma *in situ* should be completely curable
is only after invasion occurs into lymphatics and blood ves
that metastases become a probability[52] As long ago as
Cullen reported an unsuspected case of carcinoma of the
vix which was discovered accidentally while the body of
uterus was being curetted for hemorrhage caused by hy
plasia of the endometrium He stated that "It is to the e
diagnosis of carcinoma of the cervix that we must look
future success"[16] Meigs says that the early diagnosis
treatment is a prerequisite for cure, and emphasized
delay is responsible for a majority of deaths from cer
cancer[57] Younge and associates mention the first carcin
of a series which was discovered by biopsy only after
cervix failed to heal following cauterization This case
carcinoma *in situ* was seen to progress to invasive carcin
in 11 months in a deliberate experiment[90] Fremont-Sm
Graham and Meigs express the opinion that until the caus
causes of carcinoma are discovered, the only way to con
cancer is by early diagnosis and eradication at its incepti
Foote and Stewart state that it is impossible to detect ca
noma *in situ* with the naked eye even though the patholo
knows the specimen contains a cancer[29] McCollum wr
that diagnosis in the preinvasive stage is necessarily mi
scopic because most of the gross changes depend upon in
sion[56] Smith maintains that the diagnosis of preinva
cancer depends upon the ability of the pathologist to disc
when cells are assuming or have developed malignant ch
acteristics[81] An early diagnosis, therefore, requires a c
plete knowledge of the microscopic characteristics of ma
nant cells

The most extensive studies have been on the cervix,[1] however, squamous carcinoma *in situ* has been reported from skin,[7,8] oral cavity,[9] larynx,[11,14,31,76] esophagus,[43] bronchus,[4,21,31,70] kidney,[25] vulva[44,48] and adenocarcinoma *in situ* has been recorded from stomach,[52] large bowel,[4] appendix,[54] breast[28] and endometrium[39] A brief resume of selected studies will simplify the problems of understanding and treating carcinoma *in situ*.

Beginning approximately a hundred years ago, sporadic and confused attempts were made to identify the characteristics of neoplastic cells[64] Hauptmann dates studies of the cancer cell from the advent of Virchow's cellular pathology studies[36] Zemansky relates that Quincke, in 1875, published careful histological observations on chylous ascitic fluids, and in 1882 reported examinations of stained smears of a large group of peritoneal and pleural fluids in inflammatory and neoplastic conditions In 1895, Reider reported seeing mitoses for the first time in stained smears of cells free in fluid media.[61] Although as early as 1901 Mandlebaum studied actinomycotic pus by fixation and section, it was not until 1917 that his method of cellular studies by stained paraffin sections of fixed sediment of centrifuged body fluids was published.[53]

By this time numerous other pathologists more or less independently had arrived at a similar technique.[27] More rapid methods of studying cells were coming into use also about this time. In 1910 and again in 1923 Shaw published a rapid method of staining frozen sections of fresh tissues in the operating room Frozen by ether or ethyl chloride, tissue was cut and stained by dilute Loeffler's methylene blue. He had performed 540 examinations up to the time of the latter publication.[73] Closely following this, Dudgeon and Patrick reported 191 correct diagnoses out of 200 studies by a wet film method of staining fixed scrapings from cut surfaces of tumors. Dudgeon and Barrett, in 1934, wrote that over 1 000 cases had been studied by this wet-film method A year later Dudgeon and Wrigley reported their demonstration of malignant cells in sputum in 68 per cent of 38 cases of proven carcinoma of the lung by this same wet film method[18-20]

In this country, in 1912, Bowen described carefully two cases of atypical epithelial proliferation which he considered to be precancerous dermatosis By 1915 he reported the sixth such case[7,8] After much criticism and skepticism these cases of Bowen have finally been recognized as intraepidermic carcinoma or preinvasive carcinoma, and, therefore, were apparently the first cases of carcinoma *in situ* to be described[56]

McCarty has written repeatedly on studies of the differential characteristics of the cancer cell He points out that the nucleoli of cancer cells are larger in proportion to the nucleus than in nonmalignant cells These observations have been consistently found by his associates using a method of accurate cell measurements[47-50]

Thirty-five years ago Papanicolaou, of the Department of Anatomy, Cornell Medical College, began the study of morphologic and cyclic variations of cells during the sex cycle in guinea pigs by means of vaginal smears[60] The usefulness of this method of study was immediately evident In 1923, he began a systematic study of the human sex cycle by daily vaginal smears[61] He noted striking abnormalities of cancer cells and their nuclei He was immediately aware of the potentialities for diagnosis in the human Although his cytological technique was successful in diagnosing a case of uterine carcinoma which he reported in 1928, clinical men failed to recognize the possibilities of this method Papanicolaou lost enthusiasm and returned to his former work for a time[66,68]

Cullen, in 1921, reported an unsuspected early cancer of the cervix discovered by pathologic study of a specimen removed at operation[16] This has been considered one of the earliest reported cases of carcinoma *in situ*[90] This term was unknown at that time, and was not used by Broders until 1932[52,55] Pemberton and Smith had begun to talk of noninvasive carcinoma about 1929, but their ideas were not acceptable to pathologists in general at that time[51]

The introduction of aspiration or needle biopsy is another attempt to recognize cancer at an earlier stage on the basis of the characteristics of malignant cells. Martin and Ellis describe the Mixter punch, a blunt tipped trochar used for biopsy of brain tissue in the early years of this century Ward suggested needle puncture and aspiration of lymph nodes in 1912 Goeller used a special cutting-tipped trochar in 1920 for prostatic biopsy, which Martin and Ellis considered more traumatic than an 18 gauge needle Guthrie aspirated Hodgkin's nodes in 1921 Martin and Ellis began to use a sharp 18 gauge needle in 1926 for aspiration biopsies The aspirated material or plug of tissue was smeared, fixed and stained They reported 65 cases, almost half of which were from cervical lymph nodes. They describe two cases with fixed, indurated masses anteriorly and low in the neck associated with dyspnea, where the differential diagnosis of laryngeal from thyroid carcinoma was made on finding squamous cells by aspiration biopsies of the cervical masses[54] In 1927, Forkner described the use of a dental brooch introduced through an 18 gauge needle for the purpose of securing material from lymph nodes for supravital staining studies[30] Ferguson reported needle puncture and aspiration biopsies of prostatic neoplasms in 1930[31] In 1931, Sharp was diagnosing primary carcinoma of the lung by needle aspiration through the chest wall in neoplasms inaccessible to the bronchoscope,[78] and in the same year Coley, Sharp and Ellis related their successful diagnosis of bone tumors by the aspiration method[15] In 1933, Stewart reported approximately 2,500 cases of aspiration diagnosis of tumors without unfavorable result.[81] Also during these years pathologic studies, especially by sections of the surgically removed uterine cervix, were helping to clarify the ideas of preinvasive cancer cells.

It is interesting and significant that many authors refer in recent years to Bowen's Precancerous Dermatosis, first described in 1912 Sutton and Sutton wrote that Bowen's Disease or Intraepidermal Carcinoma of Bowen's type has been widely recognized in Europe since 1922, and that Wise, in 1929 found that this was a definite distinct entity with histologic features peculiar to itself and indicative of intraepidermal carcinoma. The Suttons were convinced that Bowen's disease is true carcinoma, although it remains superficial for a long time.[83] James Ewing describes it as "a peculiar, very chronic lesion of the epidermis, which doubtless represents a specific form of precancerous keratosis," occurring usually in elderly people, being single or conglomerate, localized or widely distributed, dull red, scaling or crusting, painful papules or elevated nodules in the skin, which may progress slowly, requiring 10 to 30 years before becoming malignant.[1] Mallory says that the "evolution into invasive cancer seems to be constant in Bowen's disease. The irreversible character of this evolution, and the constant presence of certain histologic features common to malignant neoplasms but foreign to inflammatory reactions gradually aroused the suspicion that such conditions represented not merely potential foci of carcinogenesis but actual carcinoma in a preinvasive stage."[52] He states that this theory was crystallized in 1933 by Schiller, who found a case of preinvasive carcinoma of the cervix while seeking a means of diagnosing carcinoma early by studying microscopic sections of all cervices removed at the Gynecological Clinic at the University of Vienna. One of his cases presented an early unsuspected noninvasive carcinoma within the cervical canal, hysterectomy having been done because of an adnexal tumor. He called this "young carcinoma," or the "early stage of carcinoma." He wrote that their experience "demonstrated that the smallest carcinomatous layer without downgrowth will later, if allowed to grow, develop into deeply penetrating carcinoma" and eventually will ulcerate superficially. He compared his cases with Bowen's to whom he credited the discovery of such findings in relation to skin.[73] Five years later Schiller again compared the biological and morphological similarity between Bowen's disease and carcinoma of the cervix. He stated that there may be many months before any appreciable change in the size of the lesion can be detected. "Rapid and excessive growth which has always been ascribed to malignant tumors, apparently does not occur until the carcinoma has reached a definite size, a certain amount of superficial disintegration, and some invasive growth."[74] Mallory writes that Broders independently arrived at the same concept and coined the phrase "carcinoma